Data Evaluation Record on the Acute Toxicity of Copper Hydroxide to Terrestrial Vascular Plants: Seedling Emergence

PMRA Submission Number {.....} **EPA MRID Number 49300301**

Data Requirement:

PMRA Data Code:	9.8.4 (TGAI) or 9.8.6 (EP)
EPA DP Barcode:	419685
OECD Data Point:	IIA 8.12 (TGAI) and IIIA 10.8.1.1 (EP)
EPA Guideline:	850.4100

Test material: Copper Hydroxide 50 WP **Purity:** 50.1%
Common name
Chemical name: IUPAC:
CAS name:
CAS No.: 20427-59-2
Synonyms: Funguran®-OH 50WP

Primary Reviewer: Joan Gaidos **Signature:**
Senior Scientist, CDM Smith **Date:** 5/14/15

Secondary Reviewer: Teri S. Myers **Signature:**
Senior Scientist, CDM Smith **Date:** 5/15/15

Primary Reviewer: Meghan Radtke, Ph.D. Biologist **Date:** 5/28/15
EPA/OPP/EFED/ERB-1

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Secondary Reviewer(s): {.....} **Date:** {.....}
{EPA/OECD/PMRA}

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Company Code	{.....}	[For PMRA]
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Use Site Category:	{.....}	[For PMRA]
EPA PC Code	023401	

Date Evaluation Completed: 28-05-2015

CITATION: Crawford, L.E, and R. L. Hummel. The Effects of Copper Hydroxide 50 WP on Seedling Emergence and Seedling Growth of Ten Species of Plants. Unpublished study performed by Landis International, Inc., Valdosta, Georgia and sponsored by Copper Sulfate Task Force, Valdosta, Georgia. Laboratory Report No.: LI-126-2013-1. Study completed January 16, 2014.

DISCLAIMER: This document provides guidance for EPA and PMRA reviewers on how to complete a data evaluation record after reviewing a scientific study concerning the acute toxicity of a pesticide to terrestrial vascular plants. It is not intended to prescribe conditions to any external party for conducting this study nor to establish absolute criteria regarding the assessment of whether the study is scientifically sound and whether the study satisfies any applicable data requirements. Reviewers are expected to review and to determine for each study, on a case-by-case basis, whether it is scientifically sound and provides sufficient information to satisfy applicable data requirements. Studies that fail to meet any of the conditions may be accepted, if appropriate; similarly, studies that meet all of the conditions may be rejected, if appropriate. In sum, the reviewer is to take into account the totality of factors related to the test methodology and results in determining the acceptability of the study.

EXECUTIVE SUMMARY:

The effect of **Copper Hydroxide (applied as Funguran-OH 50WP, 50.1% a.i.)** on the seedling emergence of monocot (Corn, *Zea mays*; Onion, *Allium cepa;* Oat, *Avena sativa;* and Sorghum, *Sorghum bicolor*) and dicot (Cucumber, *Cucumis sativus*; Buckwheat, *Fagopyrum esculentum*; Morning glory, *Ipomoea hederacea*; Radish, *Raphanus sativus*; Soybean, *Glycine max*; and Sunflower, *Helianthus annuus*) crops was studied at a nominal concentration of 0 (negative control), 20, 40, 80, 160 and 320 lb ai/A. The concentrations were measured in the soil, however concentrations were highly variable and unreliable (mean soil recovery was 87 to 335% of nominal); the study author indicated that the inconsistent results were indicative of sampling variability, rather than application variability. The reviewer based toxicity calculations on nominal concentrations.

The growth medium used in the seedling emergence test was a natural soil (sandy loam, pH 6.1, organic matter 1.3%). At study termination, the surviving plants per pot were recorded and cut at soil level for measuring the plant height and dry weight. Emergence was determined by counting the plants that had emerged throughout the study.

The emergence in the negative control was based on the number emerged during the study, and ranged from 74 to 100%. The reviewer found no significant effects on emergence with the exception of inhibitions in radish emergence of 20, 47 and 58% at the 80, 160 and 320 lb ai/A treatment levels compared to the negative control ($p<0.05$, Jonckheere-Terpstra Step-Down test).

The survival in the negative control ranged from 98 to 100%. The reviewer found no significant inhibitions in survival for most species; exceptions were a dose-dependent reduction in radish survival of 20, 47 and 60% at the 80, 160 and 320 lb ai/A treatment levels compared to the negative control ($p<0.05$, Williams test), and a non-dose-dependent reduction in oat survival of 11 and 8% at the 160 and 320 lb ai/A levels ($p<0.05$, Mann-Whitney U test).

There were significant inhibitions in dry weight for all species. The reviewer found inhibitions in dry weight for buckwheat, onion, radish, and sorghum of 20-65%, 33-55%, 14-87%, and 20-82%, respectively, at all application rates beginning at 20 or 40 lb ai/A compared to the negative control ($p<0.05$, Williams). For corn, cucumber, morning glory, oat, soybean and sunflower inhibitions were 28-71%, 15-67%, 18-67%, 11-68%, 24-38%, and 38-73% beginning at 160, 80, 80, 40, 20 and 40 lbs ai/A treatment levels, respectively ($p<0.05$; Jonckheere-Terpstra Step-Down test).

There were significant inhibitions in height for all species. The reviewer found inhibitions for height buckwheat, corn, cucumber, morning glory, oat, onion, radish, sorghum and sunflower of 27-63%, 12-46%, 14-76%, 12-78%, 10-56%, 20-33%, 38-80%, 11-73% and 36-50%, respectively, at all application rates beginning at 20, 40 or 80 lb ai/A compared to the negative control ($p<0.05$, Williams). For soybean inhibitions were 20% at the 320 lbs ai/A treatment level ($p<0.05$; Dunnett's test).

Based on the reviewers results, the most sensitive monocot species was sorghum based on dry weight, with NOAEC and IC_{25} values of <20 and 35.6 lb ai/A, respectively; and the most sensitive dicot species was radish based on dry weight, with NOAEC and IC_{25} values of <20 and 14.1 lb ai/A, respectively. It should be noted that for radish dry weight, the NOAEC, IC_{05}, IC_{10}, and IC_{25} all fell below the lowest test level; this species could have been tested at lower levels in an attempt to quantify these levels within the range of exposure concentrations.

The occurrence of phytotoxic effects was determined by counting the definitive number of stunted plats per replicate and reporting the % of live plants stunted at 14 days per treatment level. All species with the exception of soybean and sunflower, had up to 60 to 100% stunting for at least one test level, and appeared to be dose response; soybean had up to 25% and sunflower up to 19%. The negative control showed only 0-5% stunting across all species.

Maximum Labeled Rate: Not reported

Results Synopsis

Monocot

Most sensitive monocot: Sorghum, based on dry weight

IC_{50}/IC_{50}: 89.7 lb ai/A	95% C.I.: 70.3-114 lb ai/A
IC_{25}/IC_{25}: 35.6 lb ai/A	95% C.I.: 22.6-51.5 lb ai/A
IC_{05}/IC_{05}: 9.41 lb ai/A	95% C.I.: N/A-23.1 lb ai/A
NOAEC: <20 lb ai/A	
Slope: N/A	95% C.I.: N/A

Dicot

Most sensitive dicot: Radish, based on dry weight

IC_{50}/IC_{50}: 39.9 lb ai/A	95% C.I.: 30.9-51.4 lb ai/A
IC_{25}/IC_{25}: 14.1 lb ai/A	95% C.I.: 8.44-21.4 lb ai/A
IC_{05}/IC_{05}: 3.17 lb ai/A	95% C.I.: N/A-8.94 lb ai/A
NOAEC: <20 lb ai/A	
Slope: N/A	95% C.I.: N/A

Table 1 (Tier II studies). Summary of most sensitive parameters by species (lbs ai/A).

Species	Endpoint	NOEC	EC_{05}/IC_{05}	EC_{25}/IC_{25}	EC_{50}/IC_{50}
Buckwheat	Dry weight	20	6.9	39.9	135
Corn	Dry weight	80	26.8	76.8	160
Cucumber	Height	40	28.4	70.1	131
Morning Glory	Height	<20	15	49.7	114
Oat	Dry weight	20	12.1	51.1	139
Onion	Dry weight	20	5.75	40.9	160
Radish	Dry weight	<20	3.17	14.1	39.9
Sorghum	Dry weight	<20	9.41	35.6	89.7
Soybean	Dry weight	<20	0.0366	28.8	2960
Sunflower	Dry weight	20	2.3	15.9	60.9

This study is scientifically sound, but is classified as supplemental because a definitive NOEC was not established. The IC_{05} can be used in place of the NOEC for risk assessment.

I. MATERIALS AND METHODS

GUIDELINE FOLLOWED: This study was conducted in compliance with OPPTS 850.4000 and 850.4100: Seedling emergence and seedling growth (January 2012). The reviewer evaluated the study methods according to EPA Ecological Effects Test Guidelines, OCSPP Guideline 850.4100: Seedling Emergence and Seedling Growth. There were some deficiency and deviations noted by the reviewer.

1. The physico-chemical properties of the test material were not reported.

2. Confirmation measurements of copper concentrations were taken of soil instead of the liquid media applied to the pots. The study author indicated that the variability in the total copper content in the soil samples is indicative of sampling variability rather than application variability. The mean soil recovery of the test material following application was 87 to 335% of nominal.

3. Emergence is based on the total number of seedlings that emerged over the course of the study; however, the study only reports emergence at "Days 0 and 7". At study termination, survival is reported. In most cases, the controls for each species showed that seedling emergence occurred by "Day 7", but there were a few instances where the total number of surviving plants for a replicate at study termination was larger than the number of emerged plants at "Day 7". "Day 7" emergence numbers were used in the statistical analysis, unless the study termination survival number was larger. Consequently, there is some uncertainty in the survival analysis as it is possible that some plants emerged and died, and that others emerged after "Day 7". This information was not captured in the study report.

4. It should be noted that for radish dry weight, the NOAEC, IC_{05}, IC_{10}, and IC_{25} all fell below the lowest test level; this species could have been tested at lower levels in an attempt to quantify these levels within the range of exposure concentrations.

The deficiency and deviations affected the acceptability of this study.

COMPLIANCE: Signed and dated GLP, Quality Assurance and Data Confidentiality statements were provided. This study was conducted in compliance with USEPA Good Laboratory Practice Standards (40 CFR, Part 160), with the following exception: Environmental data collection at time of test material application; irrigation and irrigation data and fertilization, PAR (light intensity); and test soil history.

A. MATERIALS:

1. Test Material **Copper Hydroxide 50WP**

Description: Blue power

Lot No./Batch No.: 24007; Expiration date April 2015.

Purity: 50.1%

Stability of compound under test conditions: Analytical determinations of total copper were based on measured concentration of the test material in the test soil following 8, 12 or 26 days of storage under ambient laboratory conditions. After 8 days of storage, recoveries ranged from 40.4 to 661.9% of nominal; at 12 days, recoveries ranged from 101.3 to 265.4%; and at 26 days, recoveries ranged from 57.2 to 81.6% of nominal. The study author reported that the variability associated with the total copper content of soil samples was indicative of sampling variability rather than application variability.

(OECD recommends chemical stability in water and light)

Storage conditions of test chemicals: The test material was stored under ambient conditions out of direct sunlight.

Table 2. Physical/chemical properties of Copper Hydroxide.

Parameter	Values	Comments
Water solubility at 20˚C	Not reported	
Vapor pressure	Not reported	
UV absorption	Not reported	
pKa	Not reported	
Kow	Not reported	

2. Test organism:

Monocotyledonous species: Corn (*Zea mays*, Poaceae; Silver Queen), Onion (*Allium cepa*, Amarylidaceae; Evergreen Long White Bunching), Sorghum (*Sorghum bicolor*, Poaceae; WGF), Oat (*Avena sativa*, Poaceae; Coker 227); *EPA recommends four monocots in two families, including corn.*
Dicotyledonous species: Cucumber (*Cucumis sativus,* Cucurbitaceae; Bush Champion); Buckwheat *(Fagopyrum esculentum*, Polygonaceae, OG for sprouting); Morning glory (*Ipomoea hederacea*, Convolvulaceae; Not known); Radish (*Raphanus sativus*, Brassicaceae; Champion); Soybean (*Glycine max*, Fabaeae; Woodruff); and Sunflower (*Helianthus annuus*, Asteraceae; Teddy Bear); *EPA recommends six dicots in four families, including soybean and a root crop.*

OECD recommends a minimum of three species selected for testing, at least one from each of the following categories: Category 1: ryegrass, rice, oat, wheat, and sorghum; Category 2: mustard, rape, radish, turnip, and Chinese cabbage; Category 3: vetch, mung bean, red clover, fenugreek, lettuce, and cress.

Seed source: Onion, corn, sunflower, cucumber obtained from Burpee; Buckwheat obtained from Johnny's Selected Seeds; Oat obtained from BWI Companies; Sorghum obtained from Hancock Farm & Seed; Radish obtained from Ferry-Morse; Morning glory was field collected; and soybean obtained from Plantation Seed.
Prior seed treatment/sterilization: The seeds were not treated with any type of fungicides, insecticides, or any pesticides.
Historical % germination of seed: Corn, 98%; onion, 74%; sorghum, 95%; oat, 100%; cucumber, 100%; buckwheat, 100%; morning glory, 87%; radish, 94%; soybean, 98%; sunflower, 83%.

Seed storage, if any: Not reported.

B. STUDY DESIGN:

1. Experimental Conditions

a. Limit test: None.

b. Range-finding study: A range finding study was conducted to determine the application rates for the definitive test, which were 0, 20, 40, 80, 160 and 320 lb ai/A.

c. Definitive Study

Table 3: Experimental Parameters - Seedling Emergence.

Parameters	Seedling Emergence	
	Details	**Remarks**
		Criteria
Duration of the test	At least 14 days; Day 0 was reported as being the first day where at least 50% of the seedlings had emerged. The number of days between planting and Day 0 is unknown.	*Recommended test duration is 14-21 days.* *OECD recommends that the test be terminated no sooner than 14 days after 50 percent of the control seedlings have emerged*
Number of seeds/plants/species/ replicate	Sorghum, oat and corn: 8 pots (replicates) with 8 seeds per pot. Onion: 10 pots (replicates) with 10 seeds per pot. All others: 8 pots (replicates) with 6 seeds per pot.	*Ten seeds per replicate should be used.* *OECD recommends a minimum of five seeds planted in each replicate within 24 hours of incorporation of the test substance. All seeds of each species for each test should be of the same size class. The seed should not be imbibed.*
<u>Number of replicates</u> Control: Adjuvant control: Treated: Control: Adjuvant control: Treated:	Onion: 10 N/A 10 All others: 8 N/A 8	*Four replicates per dose should be used.* *OECD recommends a minimum of four replicates per treatment*

Parameters	Seedling Emergence	
	Details	**Remarks** ***Criteria***
Test concentrations (lb ai/A) Nominal: Measured:	0 (negative control), 20, 40, 80, 160 and 320 lb ai/A. <LOD (≤2.8), 25.2, 34.7, 138.2, 143.8 and 1072.8 lb ai/A.	The study author indicated that the variability in the total copper content in the soil samples is indicative of sampling variability rather than application variability. *Five test concentrations should be used with a dose range of 2X or 3X progression* *OECD recommends three concentrations, preferably with application rates equivalent to 0.0 (control), 1.0, 10.0 and 100 mg substance per kg of oven-dried soil.*
Method and interval of analytical verification LOQ: LOD:	Soil mixtures were analyzed by microwave assisted nitric acid extraction. Total copper was quantitated in the final extracts using inductively couple plasma atomic emission spectrometry (ICP-AES). 6.1 lb ai/A. Not reported.	
Adjuvant (type, percentage, if used)	N/A	
Test container (pot) Size/Volume Material: (glass/polystyrene)	Pots with diameter of 6 inch diameter (0.8 liters). Plastic	*Non-porous containers should be used.* *OECD recommends that non-porous plastic or glazed pot be used.*
Growth facility	Greenhouse	
Method/depth of seeding	A template was used to prepare holes and seeds introduced manually. Seeds were covered depressing the soil surface. Onion, radish and buckwheat planted at *ca*. 1 cm depth; all others at *ca*. 2 cm depth.	
Test material application		

Parameters	Seedling Emergence	
	Details	**Remarks** ***Criteria***
Application time including the plant growth stage Number of application Application interval Method of application	After planting. 1 N/A- single application Application of the test substance was made with 10 mL disposable pipette to each pot. Immediately after application, the pots were moved to the greenhouse and watered gently with a light overhead shower (<0.1 inch).	
<u>Details of soil used</u> Geographic location Depth of soil collection Soil texture % sand % silt % clay pH: % organic carbon CEC Moisture at 1/3 atm (%)	N/A N/A Sandy loam 78 7 15 6.1 Not reported 5.7 meq/100g 8.7%	Natural soil. Organic Matter: 1.3% *Soil mixes containing sandy loam, loam, or clay loam soil with no greater than 2% organic matter are preferable. Glass beads, rock wool, and 100% acid washed sand are not preferred.* *OECD prefers the soil to be sieved (0.5 cm) to remove coarse fragments. Carbon content should not exceed 1.5% (3% organic matter). Fine particles (under 20um) makeup should be between 10 and 20%. The recommended pH is between 5.0 and 7.5.*
Details of nutrient medium, if used	Not reported.	
<u>Watering regime and schedules</u> Water source/type: Volume applied: Interval of application: Method of application:	Sub-irrigation. Not reported. Not reported. Almost every day. The plants were bottom watered daily.	*EPA prefers that bottom watering be utilized for seedling emergence studies so that the chemical is not leached out of the soil during the test.*
Any pest control method/fertilization, if used	None reported.	

Parameters	Seedling Emergence	
	Details	**Remarks** ***Criteria***
Test conditions Temperature: Photoperiod: Light intensity and quality: Relative humidity:	Daytime: 48-98˚C Nighttime: 48-82˚C 16L:8D Natural sunlight supplemented with artificial light. 259-383 µmoles/m^2/sec PAR (12 hr period). 11-77%	*EPA prefers that the cold vs warm loving plants be tested in two separate groups to optimize plant growth.* *OECD prefers that the temperature, humidity and light conditions be suitable for maintaining normal growth of each species for the test period.*
Reference chemical (if used) Name: Concentrations:	N/A	
Other parameters, if any	None	

2. Observations:

Table 4: Observation Parameters - Seedling Emergence.

Parameters	Seedling Emergence	
	Details	**Remarks**
Parameters measured (e.g., number of germinated seeds, emerged seedlings, plant height, dry weight or other endpoints)	- Emergence - Survival - Shoot height - Mean dry weight - Phytotoxicity*	* The study author measured number of stunted live plants per pot/replicate.
Measurement technique for each parameter	Emergence was visually determined. Number of stunted live plants as a % of planted (phytotoxicity). Survival was defined as the percent of emerged of planted at 14 days by the study author. Mean plant weight was estimated measuring the dry weight per replicate.	
Observation intervals	Each pot was inspected weekly, emergence and	

	number of stunted live plants assessments performed. Dry weight and shoot height were recorded at study termination.	
Other observations, if any	N/A	
Were raw data included?	Yes	
Phytotoxicity rating system, if used	Instead of utilizing the 0-100 scale, which was subjective, the definitive number of stunted plants per pot/replicate was recorded and reported as % of live plants stunted at study termination (mean %/treatment level).	

II. RESULTS and DISCUSSION:

A. INHIBITORY EFFECTS:

1. Seedling Emergence:

The emergence in the negative control was based on the number emerged at "Day 7", and ranged from 88 to 100%, with the exception of onion, which had emergence in the negative control of 74%. The study author reported no significant inhibitions in emergence for any species at any treatment level, with the exception of radish ($p>0.05$, Linear Regression Analysis). The reviewer had similar findings, with inhibitions in radish emergence of 20, 47 and 58% at the 80, 160 and 320 lb ai/A treatment levels compared to the negative control ($p<0.05$, Jonckheere-Terpstra Step-Down test).

The study author survival in the negative control was based on the number emerged of planted at 14 days (study termination), and ranged from 88 to 100%, with the exception of onion, which had survival in the negative control of 74%. The study author reported no significant inhibitions in survival for any species at any treatment level, with the exception of radish ($p>0.05$, Linear Regression Analysis). The reviewer had similar findings, with inhibitions in radish survival of 20, 47 and 60% at the 80, 160 and 320 lb ai/A treatment levels compared to the negative control ($p<0.05$, Williams test).

The study author and reviewer had very similar results and found significant inhibitions in dry weight for all species. The reviewer found inhibitions in dry weight for buckwheat, onion, radish, and sorghum of 20-65%, 33-55%, 14-87%, and 20-82%, respectively, at all application rates beginning at 20 or 40 lb ai/A compared to the negative control ($p<0.05$, Williams). For corn, cucumber, morning glory, oat, soybean and sunflower inhibitions were 28-71%, 15-67%, 18-67%, 11-68%, 24-38%, and 38-73% beginning at 160, 80, 80, 40, 20 and 40 lbs ai/A treatment levels, respectively ($p<0.05$; Jonckheere-Terpstra Step-Down test).

The study author and reviewer had very similar results and found significant inhibitions in height for all species. The reviewer found inhibitions for height buckwheat, corn, cucumber, morning glory, oat, onion, radish, sorghum and sunflower of 27-63%, 12-46%, 14-76%, 12-78%, 10-56%, 20-33%, 38-80%, 11-73%

and 36-50%, respectively, at all application rates beginning at 20, 40 or 80 lb ai/A compared to the negative control ($p<0.05$, Williams). For soybean inhibitions were 20% at the 320 lbs ai/A treatment level ($p<0.05$; Dunnett's test).

Based on the study author's results, the most sensitive monocot species was sorghum based on dry weight, with NOAEC and ER_{25} values of 20 and 88 lb ai/A, respectively; and the most sensitive dicot species was radish based on dry weight, with NOAEC and ER_{25} values of 20 and 78 lb ai/A, respectively.

The occurrence of phytotoxic effects was determined by counting the definitive number of stunted plats per replicate and reporting the % of live plants stunted at 14 days per treatment level. All species with the exception of soybean and sunflower, had up to 60 to 100% stunting for at least one test level, and appeared to be dose response; soybean had up to 25% and sunflower up to 19%. The negative control showed only 0-5% stunting across all species.

B. REPORTED STATISTICS:

Emergence, survival, dry weight, and height of the control and treatment groups were compared using Microsoft Excel 2013. Statistical methods used were limited to means, standard deviations, coefficients of variation and linear regression analysis. Linear regression analyses were performed using NCSS 2000. All statistical determinations were made with 95% certainty. The EC_{25}/IC_{25} was calculated by multiplying the intercept by 25% and then dividing by the slope of the line. In cases where there were 100% toxicity (at the high application rates), the data set was truncated at 160 lb ai/A or lower, because mode zero data at higher application rates distort the regression line. Nominal concentrations were used for all analyses.

Table 5: Effect of Copper Hydroxide on 14-Day Seedling Emergence

Species	Results summary for height (lbs ai/A)									
	height (cm)	NOEC	IC_{05}	95%CI	IC_{25}	95%CI	IC_{50}	95%CI	slope	95%CI
Buckwheat[1]	7.66-20.9	40	23	N/A	113	N/A	ND	N/A	N/A	N/A
Corn[2]	20.5-38.4	40	31	N/A	156	N/A	ND	N/A	N/A	N/A
Cucumber[3]	2.5-10.8	40	18	N/A	91	N/A	ND	N/A	N/A	N/A
Morning glory[4]	2.4-11	20	18	N/A	92	N/A	ND	N/A	N/A	N/A
Oat[5]	12.9-29.4	40	27	N/A	133	N/A	ND	N/A	N/A	N/A
Onion[6]	5.69-8.93	20	48	N/A	242	N/A	ND	N/A	N/A	N/A
Radish[7]	2.17-10.8	20	16	N/A	82	N/A	ND	N/A	N/A	N/A
Sorghum[8]	8.33-30.8	20	20	N/A	99	N/A	ND	N/A	N/A	N/A
Soybean[9]	13.6-17.4	160	86	N/A	430	N/A	ND	N/A	N/A	N/A
Sunflower[10]	1.14-2.29	40	29	N/A	147	N/A	ND	N/A	N/A	N/A

ND- Not determined. NC- Not calculable. All statistical calculations were made using linear regression analysis (NCSS, 2000).
1 Significant decrease in buckwheat height, inhibition of 27, 54 and 63% at the 80, 160 and 320 lb ai/A treatments compared to the negative control ($p<0.05$).
2 Significant decrease in corn height, inhibition of 12, 34 and 46% at the 80, 160 and 320 lb ai/A treatments compared to the negative control ($p<0.05$).
3 Significant decrease in cucumber height, inhibition of 13, 73 and 76% at the 80, 160 and 320 lb ai/A treatments compared to the negative control ($p<0.05$).
4 Significant decrease in morning glory height, inhibition of 19, 34, 67 and 78% at the 40, 80, 160 and 320 lb ai/A treatments compared to the negative control ($p<0.05$).
5 Significant decrease in oat height, inhibition of 28, 42 and 56% at the 80, 160 and 320 lb ai/A treatments compared to the negative control ($p<0.05$).
6 Significant decrease in onion height, inhibition of 20, 24, 27 and 33% at the 40, 80, 160 and 320 lb ai/A treatments compared to the negative control ($p<0.05$).
7 Significant decrease in radish height, inhibition of 38, 72, 75 and 82% at the 40, 80, 160 and 320 lb ai/A treatments compared to the negative control ($p<0.05$).
8 Significant decrease in sorghum height, inhibition of 18, 43, 70 and 74% at the 40, 80, 160 and 320 lb ai/A treatments compared to the negative control ($p<0.05$).
9 Significant decrease in soybean height, inhibition of 20% at the 320 lb ai/A treatments compared to the negative control ($p<0.05$); Due to the small slope values for soybean, the calculation in the NOEC resulted in these values. IC05 and IC25 values are more reflective of the results for this crop.
10 Significant decrease in sunflower height, inhibition of 36, 50 and 47% at the 80, 160 and 320 lb ai/A treatments compared to the negative control ($p<0.05$).

Table 5a: Effect of Copper Hydroxide on 14-Day Seedling Emergence

Species	Results summary for biomass (lbs ai/A)									
	weight (g)	NOEC	IC_{05}	95%CI	IC_{25}	95%CI	IC_{50}	95%CI	slope	95%CI
Buckwheat[1]	0.0655-0.186	40	22	N/A	111	N/A	ND	N/A	N/A	N/A
Corn[2]	0.167-0.574	40	21	N/A	103	N/A	ND	N/A	N/A	N/A
Cucumber[3]	0.0478-0.149	40	21	N/A	103	N/A	ND	N/A	N/A	N/A
Morning glory[4]	0.049-0.168	40	21	N/A	103	N/A	ND	N/A	N/A	N/A
Oat[5]	0.017-0.0528	40	21	N/A	106	N/A	ND	N/A	N/A	N/A
Onion[6]	0.00319-0.00845	20	23	N/A	117	N/A	ND	N/A	N/A	N/A
Radish[7]	0.0113-0.0845	20	16	N/A	78	N/A	ND	N/A	N/A	N/A
Sorghum[8]	0.0177-0.0998	20	18	N/A	88	N/A	ND	N/A	N/A	N/A
Soybean[9]	0.225-0.364	160	52	N/A	261	N/A	ND	N/A	N/A	N/A
Sunflower[10]	0.0294-0.112	20	19	N/A	97	N/A	ND	N/A	N/A	N/A

ND- Not determined. NC- Not calculable. All statistical calculations were made using linear regression analysis (NCSS, 2000).

1 Significant decrease in buckwheat dry weight, inhibition of 37, 60 and 67% at the 80, 160 and 320 lb ai/A treatments compared to the negative control ($p<0.05$).

2 Significant decrease in corn dry weight, inhibition of 16, 58 and 71% at the 80, 160 and 320 lb ai/A treatments compared to the negative control ($p<0.05$).

3 Significant decrease in cucumber dry weight, inhibition of 15, 61 and 70% at the 80, 160 and 320 lb ai/A treatments compared to the negative control ($p<0.05$).

4 Significant decrease in morning glory dry weight, inhibition of 18, 54 and 71% at the 80, 160 and 320 lb ai/A treatments compared to the negative control ($p<0.05$).

5 Significant decrease in oat dry weight, inhibition of 38, 56 and 71% at the 80, 160 and 320 lb ai/A treatments compared to the negative control ($p<0.05$).

6 Significant decrease in onion dry weight, inhibition of 32, 42, 48 and 54% at the 40, 80, 160 and 320 lb ai/A treatments compared to the negative control ($p<0.05$).

7 Significant decrease in radish dry weight, inhibition of 48, 82, 79 and 90% at the 40, 80, 160 and 320 lb ai/A treatments compared to the negative control ($p<0.05$).

8 Significant decrease in sorghum dry weight, inhibition of 26, 44, 73 and 84% at the 40, 80, 160 and 320 lb ai/A treatments compared to the negative control ($p<0.05$).

9 Significant decrease in soybean dry weight, inhibition of 38% at the 320 lb ai/A treatments compared to the negative control ($p<0.05$); Due to the small slope values for soybean, the calculation in the NOEC resulted in these values. IC05 and IC25 values are more reflective of the results for this crop.

10 Significant decrease in sunflower dry weight, inhibition of 38, 62, 74 and 73% at the 40, 80, 160 and 320 lb ai/A treatments compared to the negative control ($p<0.05$).

Table 5b: Effect of Copper Hydroxide on 14-Day Seedling Emergence

Species	Results summary for emergence (lbs ai/A); based on 7-day emergence.									
	%	NOEC	EC_{05}	95%CI	EC_{25}	95%CI	EC_{50}	95%CI	slope	95%CI
Buckwheat	98-100	320	N/A	N/A	N/A	N/A	ND	N/A	N/A	N/A
Corn	98-100	320	N/A	N/A	N/A	N/A	ND	N/A	N/A	N/A
Cucumber	96-100	320	N/A	N/A	N/A	N/A	ND	N/A	N/A	N/A
Morning glory	88-100	320	N/A	N/A	N/A	N/A	ND	N/A	N/A	N/A
Oat	91-100	320	N/A	N/A	N/A	N/A	ND	N/A	N/A	N/A
Onion	69-79	320	N/A	N/A	N/A	N/A	ND	N/A	N/A	N/A
Radish[1]	40-94	40	24	N/A	122	N/A	ND	N/A	N/A	N/A
Sorghum	95-98	320	N/A	N/A	N/A	N/A	ND	N/A	N/A	N/A
Soybean	98-100	320	N/A	N/A	N/A	N/A	ND	N/A	N/A	N/A
Sunflower	87-92	320	N/A	N/A	N/A	N/A	ND	N/A	N/A	N/A

ND- Not determined. NC- Not calculable. All statistical calculations were made using linear regression analysis (NCSS, 2000).
1 Significant inhibition in radish emergence at the 80, 160 and 320 lb ai/A treatments compared to the negative control; inhibitions not reported ($p<0.05$).

Table 5c: Effect of Copper Hydroxide on 14-Day Seedling Emergence

Species	Results summary for survival (lbs ai/A); based on 14 day emergence.									
	%	NOEC	EC_{05}	95%CI	EC_{25}	95%CI	EC_{50}	95%CI	slope	95%CI
Buckwheat	98-100	320	N/A	N/A	N/A	N/A	ND	N/A	N/A	N/A
Corn	98-100	320	N/A	N/A	N/A	N/A	ND	N/A	N/A	N/A
Cucumber	96-100	320	N/A	N/A	N/A	N/A	ND	N/A	N/A	N/A
Morning glory	88-96	320	N/A	N/A	N/A	N/A	ND	N/A	N/A	N/A
Oat	89-100	320	N/A	N/A	N/A	N/A	ND	N/A	N/A	N/A
Onion	66-77	320	N/A	N/A	N/A	N/A	ND	N/A	N/A	N/A
Radish[1]	38-94	40	24	N/A	121	N/A	ND	N/A	N/A	N/A
Sorghum	95-97	320	N/A	N/A	N/A	N/A	ND	N/A	N/A	N/A
Soybean	98-100	320	N/A	N/A	N/A	N/A	ND	N/A	N/A	N/A
Sunflower	73-90	320	N/A	N/A	N/A	N/A	ND	N/A	N/A	N/A

ND- Not determined. NC- Not calculable. All statistical calculations were made using linear regression analysis (NCSS, 2000).
1 Significant inhibition in radish survival at the 80, 160 and 320 lb ai/A treatments compared to the negative control; inhibitions not reported ($p<0.05$).

Mid-study emergence											
Control	Corn	Oat	Sorghum	Onion	Morning Glory	Soybean	Buckwheat	Radish	Cucumber	Sunflower	Formulation Blank
74-100	97-100	88-100	92-97	69-77	88-98	94-100	96-100	40-94	96-100	73-92	N/A

Plant Injury Index*; % of live plants stunted at 14 days (mean %/treatment level)											
Control	Corn	Oat	Sorghum	Onion	Morning Glory	Soybean	Buckwheat	Radish	Cucumber	Sunflower	Formulation Blank
0-5	5-60	0-98	3-88	0-100	0-86	0-25	2-77	2-100	0-94	3-19	N/A

*Instead of utilizing the 0-100 scale, which was subjective, the definitive number of stunted plants per pot/replicate was recorded and reported as % of live plants stunted at 14 days (mean %/treatment level).

C. VERIFICATION OF STATISTICAL RESULTS BY THE REVIEWER:

All analyses were conducted comparing treated to the negative control. These analyses were conducted using CETIS version 1.8.7.12 and backend settings approved for use by EFED on 3/25/14. Data for each endpoint were tested to determine if their distributions were normal and if their variances were homogeneous using Shapiro-Wilk's and Levene's tests, respectively. Data that satisfied these assumptions were subjected to Dunnett's and William's tests, and data that did not satisfy these assumptions were subjected to the non-parametric MannWhitney-U and Jonckheere's tests. Nominal concentrations were used for all analyses. Linear (survival and emergence) and nonlinear (height and dry weight) regression models were used to interpret EC/ICx values. Data for emergence were based on the total number of seedlings that emerged during the test and data for survival was based on the number of surviving plants at study termination divided by the total number of emerged seedlings.

Table 6: Effect of Copper Hydroxide on Seedling Emergence

Species	Results summary for height (lbs ai/A)									
	height (cm)	NOEC	IC_{05}	95%CI	IC_{25}	95%CI	IC_{50}	95%CI	slope	95%CI
Buckwheat[1]	7.66-20.9	40	16.5	NA-31.3	65.6	48-86.2	171	144-204	N/A	N/A
Corn[2]	20.5-38.4	40	32.7	NA-57.1	126	93.1-164	323	248-421	N/A	N/A
Cucumber[3]	2.5-10.8	40	28.4	NA-43.1	70.1	54.6-86.6	131	114-152	N/A	N/A
Morning glory[4]	2.4-11	<20	15	NA-24	49.7	40.4-59.7	114	101-128	N/A	N/A
Oat[5]	12.9-29.4	20	15.1	3.18-26.2	74.6	59.2-92.2	227	194-265	N/A	N/A
Onion[6]	5.69-8.93	20	7.11	NA-22.9	116	79.2-165	809	349-1870	N/A	N/A
Radish[7]	2.17-10.8	20	4.04	NA-10.3	18.8	12.4-26.8	54.9	44.6-67.6	N/A	N/A
Sorghum[8]	8.33-30.8	<20	9.9	NA-18.7	41.8	32.2-52.9	114	98.5-132	N/A	N/A
Soybean[9]	13.6-17.4	160	177	NA-237	370	301-441	619	344-1110	N/A	N/A
Sunflower[10]	1.14-2.29	40	6.2	NA-17.6	53.3	35.3-76.7	237	176-320	N/A	N/A

ND- Not determined. NC- Not calculable.

1 Significant decrease in buckwheat height, inhibition of 27, 54 and 63% at the 80, 160 and 320 lb ai/A treatments compared to the negative control (Williams test, $p<0.05$).

2 Significant decrease in corn height, inhibition of 12, 34 and 46% at the 80, 160 and 320 lb ai/A treatments compared to the negative control (Williams test, $p<0.05$).

3 Significant decrease in cucumber height, inhibition of 14, 73 and 76% at the 80, 160 and 320 lb ai/A treatments compared to the negative control (Williams test, $p<0.05$).

4 Significant decrease in morning glory height, inhibition of 12, 19, 34, 67 and 78% at the 20, 40, 80, 160 and 320 lb ai/A treatments compared to the negative control (Williams test, $p<0.05$).

5 Significant decrease in oat height, inhibition of 10, 28, 42 and 56% at the 40, 80, 160 and 320 lb ai/A treatments compared to the negative control (Williams test, $p<0.05$).

6 Significant decrease in onion height, inhibition of 20, 24, 27 and 33% at the 40, 80, 160 and 320 lb ai/A treatments compared to the negative control (Williams test, $p<0.05$).

7 Significant decrease in radish height, inhibition of 38, 72, 75 and 80% at the 40, 80, 160 and 320 lb ai/A treatments compared to the negative control (Williams test, $p<0.05$).

8 Significant decrease in sorghum height, inhibition of 11, 18, 41, 64 and 73% at the 20, 40, 80, 160 and 320 lb ai/A treatments compared to the negative control (Williams test, $p<0.05$).

9 Significant decrease in soybean height, inhibition of 20% at the 320 lb ai/A treatments compared to the negative control (Dunnett's test, $p<0.05$).

10 Significant decrease in sunflower height, inhibition of 36, 50 and 48% at the 80, 160 and 320 lb ai/A treatments compared to the negative control (Williams test, $p<0.05$).

Table 6a: Effect of Copper Hydroxide on Seedling Emergence

Species	Results summary for biomass (lbs ai/A)									
	weight (g)	NOEC	IC_{05}	95%CI	IC_{25}	95%CI	IC_{50}	95%CI	slope	95%CI
Buckwheat[1]	0.0655-0.186	20	6.9	NA-20.4	39.9	24.1-60.9	135	104-175	N/A	N/A
Corn[2]	0.167-0.574	80	26.8	NA-52.2	76.8	47.7-111	160	126-203	N/A	N/A
Cucumber[3]	0.0478-0.149	40	24.4	NA-38.5	73.7	57.7-91.3	159	139-182	N/A	N/A
Morning glory[4]	0.049-0.168	40	26.2	NA-42.8	76.4	57.4-97.3	161	138-188	N/A	N/A
Oat[5]	0.017-0.0528	20	12.1	NA-24.8	51.1	36.8-67.9	139	116-166	N/A	N/A
Onion[6]	0.00319-0.00845	20	5.75	NA-22.1	40.9	21.3-69.7	160	113-226	N/A	N/A
Radish[7]	0.0113-0.0845	<20	3.17	NA-8.94	14.1	8.44-21.4	39.9	30.9-51.4	N/A	N/A
Sorghum[8]	0.0177-0.0998	<20	9.41	NA-23.1	35.6	22.6-51.5	89.7	70.3-114	N/A	N/A
Soybean[9]	0.225-0.364	<20	0.0366	NA-3.38	28.8	7.19-97.2	2960	146-59900	N/A	N/A
Sunflower[10]	0.0294-0.112	20	2.3	NA-11.9	15.9	6.1-32.5	60.9	41.1-90.4	N/A	N/A

ND- Not determined. NC- Not calculable.

1 Significant decrease in buckwheat dry weight, inhibition of 20, 38, 60 and 65% at the 40, 80, 160 and 320 lb ai/A treatments compared to the negative control (Williams test, $p<0.05$).

2 Significant decrease in corn dry weight, inhibition of 58 and 71% at the 160 and 320 lb ai/A treatments compared to the negative control (Jonckheere-Terpstra Step-Down test, $p<0.05$).

3 Significant decrease in cucumber dry weight, inhibition of 15, 61 and 67% at the 80, 160 and 320 lb ai/A treatments compared to the negative control (Jonckheere-Terpstra Step-Down test, $p<0.05$).

4 Significant decrease in morning glory dry weight, inhibition of 18, 54 and 67% at the 80, 160 and 320 lb ai/A treatments compared to the negative control (Jonckheere-Terpstra Step-Down test, $p<0.05$).

5 Significant decrease in oat dry weight, inhibition of 11, 38, 56 and 68% at the 40, 80, 160 and 320 lb ai/A treatments compared to the negative control (Jonckheere-Terpstra Step-Down test, $p<0.05$).

6 Significant decrease in onion dry weight, inhibition of 33, 42, 49 and 55% at the 40, 80, 160 and 320 lb ai/A treatments compared to the negative control (Williams test, $p<0.05$).

7 Significant decrease in radish dry weight, inhibition of 14, 48, 82, 79 and 87% at the 20, 40, 80, 160 and 320 lb ai/A treatments compared to the negative control (Williams test, $p<0.05$).

8 Significant decrease in sorghum dry weight, inhibition of 20, 27, 45, 69 and 82% at the 20, 40, 80, 160 and 320 lb ai/A treatments compared to the negative control (Williams test, $p<0.05$).

9 Significant decrease in soybean dry weight, inhibition of 24, 28, 26, 34 and 38% at the 20, 40, 80, 160 and 320 lb ai/A treatments compared to the negative control (Jonckheere-Terpstra Step-Down test, $p<0.05$).

10 Significant decrease in sunflower dry weight, inhibition of 38, 62, 74 and 73% at the 40, 80, 160 and 320 lb ai/A treatments compared to the negative control (Jonckheere-Terpstra Step-Down test, $p<0.05$).

Table 6b: Effect of Copper Hydroxide on Seedling Emergence

Species	Results summary for emergence (lbs ai/A)									
	%	NOEC	EC_{05}	95%CI	EC_{25}	95%CI	EC_{50}	95%CI	slope	95%CI
Buckwheat	98-100	320	>320	N/A	>320	N/A	>320	N/A	N/A	N/A
Corn	98-100	320	>320	N/A	>320	N/A	>320	N/A	N/A	N/A
Cucumber	96-100	320	>320	N/A	>320	N/A	>320	N/A	N/A	N/A
Morning glory	88-100	320	>320	N/A	>320	N/A	>320	N/A	N/A	N/A
Oat[1]	91-100	80	>320	N/A	>320	N/A	>320	N/A	N/A	N/A
Onion	69-79	320	>320	N/A	>320	N/A	>320	N/A	N/A	N/A
Radish[2]	40-94	40	19.7	9.3-30.8	77.6	56.5-100	201	152-297	1.63	1.16-2.11
Sorghum	95-98	320	>320	N/A	>320	N/A	>320	N/A	N/A	N/A
Soybean	98-100	320	>320	N/A	>320	N/A	>320	N/A	N/A	N/A
Sunflower	87-92	320	>320	N/A	>320	N/A	>320	N/A	N/A	N/A

ND- Not determined. NC- Not calculable.

1 Significant decrease in oat emergence, inhibition of 9 and 8% at the 160 and 320 lb ai/a treatments compared to the negative control (Mann-Whitney U test, $p<0.05$); a significant 6% reduction was detected at the 40 lb ai/A treatment, but the same magnitude reduction was not significant ($p>0.05$) at the 80 lb ai/A level, so these reductions were not considered to be treatment-related, while the effects at the two highest levels were.

2 Significant decrease in radish emergence, inhibition of 20, 47 and 58% at the 80, 160 and 320 lb ai/A treatments compared to the negative control (Jonckheere-Terpstra Step-Down test, $p<0.05$).

Table 6c: Effect of Copper Hydroxide on Seedling Emergence

Species	Results summary for survival (lbs ai/A); based on # planted									
	%	NOEC	EC_{05}	95%CI	EC_{25}	95%CI	EC_{50}	95%CI	slope	95%CI
Buckwheat	98-100	320	>320	N/A	>320	N/A	>320	N/A	N/A	N/A
Corn	98-100	320	>320	N/A	>320	N/A	>320	N/A	N/A	N/A
Cucumber	96-100	320	>320	N/A	>320	N/A	>320	N/A	N/A	N/A
Morning glory	88-96	320	>320	N/A	>320	N/A	>320	N/A	N/A	N/A
Oat[2]	89-100	80	>320	N/A	>320	N/A	>320	N/A	N/A	N/A
Onion	66-77	320	>320	N/A	>320	N/A	>320	N/A	N/A	N/A
Radish[1]	38-94	40	18.9	8.87-29.6	74.3	53.9-96.2	193	147-282	1.63	1.16-2.1
Sorghum	95-97	320	>320	N/A	>320	N/A	>320	N/A	N/A	N/A
Soybean	98-100	320	>320	N/A	>320	N/A	>320	N/A	N/A	N/A
Sunflower	73-90	320	>320	N/A	>320	N/A	>320	N/A	N/A	N/A

ND- Not determined. NC- Not calculable.

1 Significant decrease in oat survival, inhibition of 11 and 8% at the 160 and 320 lb ai/a treatments compared to the negative control (Mann-Whitney U test, $p<0.05$); a significant 6% reduction was detected at the 40 lb ai/A treatment, but no significant reduction (2%; $p>0.05$) at the 80 lb ai/A level, so only effects at the two highest levels were considered to be treatment-related, particularly when considering effects on emergence at these levels.

2 Significant decrease in radish survival, inhibition of 20, 47 and 60% at the 80, 160 and 320 lb ai/A treatments compared to the negative control (Williams test, $p<0.05$).

Mid-study emergence											
Control	Corn	Oat	Sorghum	Onion	Morning Glory	Soybean	Buckwheat	Radish	Cucumber	Sunflower	Formulation Blank
74-100	97-100	88-100	92-97	69-77	88-98	94-100	96-100	40-94	96-100	73-92	N/A

Plant Injury Index*; % of live plants stunted at study termination (mean %/treatment level)											
Control	Corn	Oat	Sorghum	Onion	Morning Glory	Soybean	Buckwheat	Radish	Cucumber	Sunflower	Formulation Blank
0-5	5-60	0-98	3-88	0-100	0-86	0-25	2-77	2-100	0-94	3-19	N/A

*Instead of utilizing the 0-100 scale, which was subjective, the definitive number of stunted plants per pot/replicate was recorded and reported as % of live plants stunted at 14 days (mean %/treatment level).

Monocot

Most sensitive monocot: Sorghum, based on dry weight

EC_{50}/IC_{50}: 89.7 lb ai/A 95% C.I.: 70.3-114 lb ai/A
EC_{25}/IC_{25}: 35.6 lb ai/A 95% C.I.: 22.6-51.5 lb ai/A
EC_{05}/IC_{05}: 9.41 lb ai/A 95% C.I.: N/A-23.1 lb ai/A
NOAEC: <20 lb ai/A
Slope: N/A 95% C.I.: N/A

Dicot

Most sensitive dicot: Radish, based on dry weight

EC_{50}/IC_{50}: 39.9 lb ai/A 95% C.I.: 30.9-51.4 lb ai/A
EC_{25}/IC_{25}: 14.1 lb ai/A 95% C.I.: 8.44-21.4 lb ai/A
EC_{05}/IC_{05}: 3.17 lb ai/A 95% C.I.: N/A-8.94 lb ai/A
NOAEC: <20 lb ai/A
Slope: N/A 95% C.I.: N/A

D. STUDY DEFICIENCIES:

1. The physico-chemical properties of the test material were not reported.

2. The study author indicated that the variability in the total copper content in the soil samples is indicative of sampling variability rather than application variability. The mean soil recovery of the test material following application was 87 to 335% of nominal.

   According to the methods section, the application of the test substance was made with a 10 mL disposable pipette to each pot, and then the pots were immediately gently watered with a light overhead shower. There is no indication that the test material was otherwise incorporated into the test soil or attempts made to produce a homogeneous treated soil mixture and the application was not made using a fine nozzle (TeeJet).

3. Instead of utilizing the 0-100 scale, which was subjective, the definitive number of stunted plants per pot/replicate was recorded and reported as % of live plants stunted at 14 days (mean %/treatment level).

4. Emergence is based on the total number of seedlings that emerged over the course of the study; however, the study only reports emergence at "Days 0 and 7". At study termination, survival is reported. In most cases, the controls for each species showed that seedling emergence occurred by "Day 7", but there were a few instances where the total number of surviving plants for a replicate at study termination was larger than the number of emerged plants at "Day 7". "Day 7" emergence numbers were used in the statistical analysis, unless the study termination survival number was larger. Consequently, there is some uncertainty in the survival analysis as it is possible that some plants emerged and died, and that others emerged after "Day 7". This information was not captured in the study report.

5. It should be noted that for radish dry weight, the NOAEC, IC_{05}, IC_{10}, and IC_{25} all fell below the lowest test level; this species could have been tested at lower levels in an attempt to quantify these levels within the range of exposure concentrations.

E. REVIEWER'S COMMENTS:

The reviewer and study author results are in general agreement. Based on the study author's results, the most sensitive monocot species was sorghum based on dry weight, with NOAEC and ER_{25} values of 20 and 88 lb ai/A, respectively; and the most sensitive dicot species was radish based on dry weight, with NOAEC and ER_{25} values of 20 and 78 lb ai/A, respectively. In comparison, based on the reviewers results, the most sensitive monocot species was sorghum based on dry weight, with NOAEC and IC_{25} values of <20 and 35.6 lb ai/A, respectively; and the most sensitive dicot species was radish based on dry weight, with NOAEC and IC_{25} values of <20 and 14.1 lb ai/A, respectively. The differences are likely due to different statistical methods of analysis. The reviewer's results are presented in the Executive Summary and Conclusions sections of this DER.

The in-life portion of this study was initiated on September 27, 2013 to January 16, 2014.

F. CONCLUSIONS:

This study is scientifically sound, but classified as "supplemental" because a definitive NOAEC was not established and other minor deficiencies in the study's methodology. The most sensitive monocot species was sorghum based on dry weight, with NOAEC and IC_{25} values of <20 and 35.6 lb ai/A, respectively; and the most sensitive dicot species was radish based on dry weight, with NOAEC and IC_{25} values of <20 and 14.1 lb ai/A, respectively. The study may be used quantitatively in risk assessments.

Most sensitive monocot and IC_{25}: Sorghum (dry weight, 35.6 lb ai/A).
Most sensitive dicot and IC_{25}: Radish (dry weight, 14.1 lb ai/A); It should be noted that for radish dry weight, the NOAEC, IC_{05}, IC_{10}, and IC_{25} all fell below the lowest test level; this species could have been tested at lower levels in an attempt to quantify these levels within the range of exposure concentrations.

III. <u>REFERENCES</u>: None reported.

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Batch ID:	16-1542-1347	**Test Type:**	Seedling Emergence Tier II	**Analyst:**	
Start Date:	27 Sep-13	**Protocol:**	OCSPP 850.4100 Plant Seedling Emergen	**Diluent:**	
Ending Date:	20 Apr-15 16:37	**Species:**	Fagopyrum esculentum	**Brine:**	
Duration:	570d 17h	**Source:**	Johnny's Selected Seeds, ME	**Age:**	

Sample ID:	01-3712-9975	**Code:**	49300301 buckwh	**Client:**	EPA OCSPP EFED
Sample Date:	27 Sep-13	**Material:**	Copper hydroxide	**Project:**	
Receive Date:	20 Apr-15 16:37	**Source:**	Copper Sulfate Task Force, Valdosta, GA		
Sample Age:	NA	**Station:**			

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
01-1035-8118	Mean Height	40	80	56.57	16.1%		Dunnett Multiple Comparison Test
17-4285-0715	Mean Height	40	80	56.57	12.6%		Williams Multiple Comparison Test
21-0130-2004	Mean Weight	40	80	56.57	20.8%		Dunnett Multiple Comparison Test
18-1888-7048	Mean Weight	20	40	28.28	16.2%		Williams Multiple Comparison Test
21-2582-0682	Percent Emerged	320	>320	NA	3.0%		Mann-Whitney U Two-Sample Test
16-1368-7554	Percent Survived	320	>320	NA	3.0%		Mann-Whitney U Two-Sample Test

Point Estimate Summary

Analysis ID	Endpoint	Level		95% LCL	95% UCL	TU	Method
01-7928-6614	Mean Height	IC5	16.5	N/A	31.3		Nonlinear Regression
		IC10	27.7	13.8	42.1		
		IC25	65.6	48	86.2		
		IC50	171	144	204		
16-6456-1501	Mean Weight	IC5	6.9	N/A	20.4		Nonlinear Regression
		IC10	13.3	2.35	27.1		
		IC25	39.9	24.1	60.9		
		IC50	135	104	175		
07-4635-6208	Percent Emerged	EC5	1290	N/A	N/A		Linear Regression (MLE)
		EC10	4200	N/A	N/A		
		EC25	30400	N/A	N/A		
		EC50	274000	N/A	N/A		
08-2265-6462	Percent Survived	EC5	1290	N/A	N/A		Linear Regression (MLE)
		EC10	4200	N/A	N/A		
		EC25	30400	N/A	N/A		
		EC50	274000	N/A	N/A		

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Mean Height Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	20.9	18.7	23.1	16.7	23.5	0.926	2.62	12.5%	0.0%
20		8	19.8	16.6	23	15	26	1.35	3.82	19.3%	5.14%
40		8	19.2	17.4	20.9	16.5	22.3	0.738	2.09	10.9%	8.37%
80		8	15.2	12.4	18.1	9.8	20.2	1.19	3.37	22.1%	27.1%
160		8	9.66	7.31	12	5.3	13.5	0.993	2.81	29.1%	53.8%
320		8	7.66	5.64	9.69	3.7	10.3	0.856	2.42	31.6%	63.3%

Mean Weight Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.186	0.158	0.215	0.12	0.23	0.0121	0.0344	18.4%	0.0%
20		8	0.159	0.116	0.203	0.095	0.225	0.0182	0.0516	32.4%	14.5%
40		8	0.15	0.128	0.171	0.112	0.192	0.00902	0.0255	17.1%	19.8%
80		8	0.117	0.0923	0.141	0.076	0.163	0.0103	0.0291	24.9%	37.5%
160		8	0.0746	0.0527	0.0965	0.0333	0.107	0.00926	0.0262	35.1%	60.0%
320		8	0.0655	0.0427	0.0884	0.0267	0.095	0.00967	0.0274	41.7%	64.8%

Percent Emerged Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	1	1	1	1	1	0	0	0.0%	0.0%
20		8	1	1	1	1	1	0	0	0.0%	0.0%
40		8	1	1	1	1	1	0	0	0.0%	0.0%
80		8	0.979	0.93	1	0.833	1	0.0208	0.0589	6.02%	2.08%
160		8	1	1	1	1	1	0	0	0.0%	0.0%
320		8	0.979	0.93	1	0.833	1	0.0208	0.0589	6.02%	2.08%

Percent Survived Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	1	1	1	1	1	0	0	0.0%	0.0%
20		8	1	1	1	1	1	0	0	0.0%	0.0%
40		8	1	1	1	1	1	0	0	0.0%	0.0%
80		8	0.979	0.93	1	0.833	1	0.0208	0.0589	6.02%	2.08%
160		8	1	1	1	1	1	0	0	0.0%	0.0%
320		8	0.979	0.93	1	0.833	1	0.0208	0.0589	6.02%	2.08%

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Mean Height Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	16.7	21.8	21	21.7	17	22.5	23.5	23
20		18	23.5	21.3	16.2	17.3	15	21.3	26
40		17.2	18.5	20.5	17.2	20.3	16.5	20.7	22.3
80		17.7	11.8	14.5	15.3	9.8	14.8	17.8	20.2
160		12	10	5.3	13.5	9.7	11.8	6.5	8.5
320		6.2	3.7	10.3	9.3	5.7	6.7	10.2	9.2

Mean Weight Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	0.12	0.185	0.175	0.23	0.223	0.17	0.188	0.2
20		0.127	0.213	0.16	0.118	0.122	0.095	0.215	0.225
40		0.112	0.155	0.162	0.135	0.148	0.125	0.168	0.192
80		0.135	0.08	0.11	0.12	0.076	0.113	0.135	0.163
160		0.08	0.0933	0.0333	0.0967	0.0733	0.107	0.04	0.0733
320		0.046	0.0267	0.0817	0.0933	0.04	0.0517	0.095	0.09

Percent Emerged Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	1	1	1	1	1	1	1	1
20		1	1	1	1	1	1	1	1
40		1	1	1	1	1	1	1	1
80		1	1	1	1	0.833	1	1	1
160		1	1	1	1	1	1	1	1
320		0.833	1	1	1	1	1	1	1

Percent Survived Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	1	1	1	1	1	1	1	1
20		1	1	1	1	1	1	1	1
40		1	1	1	1	1	1	1	1
80		1	1	1	1	0.833	1	1	1
160		1	1	1	1	1	1	1	1
320		0.833	1	1	1	1	1	1	1

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Batch ID:	01-2432-1035	**Test Type:**	Seedling Emergence Tier II	**Analyst:**	
Start Date:	27 Sep-13	**Protocol:**	OCSPP 850.4100 Plant Seedling Emergen	**Diluent:**	
Ending Date:		**Species:**	Zea mays	**Brine:**	
Duration:	NA	**Source:**	Burpee	**Age:**	

Sample ID:	09-2434-4478	**Code:**	49300301 corn	**Client:**	EPA OCSPP EFED
Sample Date:	27 Sep-13	**Material:**	Copper hydroxide	**Project:**	
Receive Date:		**Source:**	Copper Sulfate Task Force, Valdosta, GA		
Sample Age:	NA	**Station:**			

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
11-9595-7571	Mean Height	80	160	113.1	15.6%		Dunnett Multiple Comparison Test
00-9294-0558	Mean Height	40	80	56.57	12.2%		Williams Multiple Comparison Test
01-6644-0832	Mean Weight	80	160	113.1	NA		Jonckheere-Terpstra Step-Down Test
08-5229-3778	Mean Weight	80	160	113.1	22.4%		Mann-Whitney U Two-Sample Test
21-4697-5019	Percent Emerged	320	>320	NA	2.8%		Mann-Whitney U Two-Sample Test
20-2478-1372	Percent Survived	320	>320	NA	3.23%		Mann-Whitney U Two-Sample Test

Point Estimate Summary

Analysis ID	Endpoint	Level		95% LCL	95% UCL	TU	Method
11-4690-5747	Mean Height	IC5	32.7	N/A	57.1		Nonlinear Regression
		IC10	54.2	26.5	82.5		
		IC25	126	93.1	164		
		IC50	323	248	421		
00-0431-6319	Mean Weight	IC5	26.8	N/A	52.2		Nonlinear Regression
		IC10	39.7	N/A	64.7		
		IC25	76.8	47.7	111		
		IC50	160	126	203		
01-6684-3775	Percent Survived	EC5	4070	N/A	N/A		Linear Regression (MLE)
		EC10	27600	N/A	N/A		
		EC25	678000	N/A	N/A		
		EC50	23700000	N/A	N/A		

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Mean Height Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	38.3	35.7	40.9	32.3	41.6	1.1	3.11	8.13%	0.0%
20		8	38.4	35.4	41.4	31.1	41.3	1.26	3.58	9.32%	-0.23%
40		8	38.4	36	40.8	34.4	42.9	1.02	2.9	7.54%	-0.33%
80		8	33.5	28.9	38.2	25.5	43.1	1.96	5.54	16.5%	12.4%
160		8	25.3	20.2	30.4	19.1	36.6	2.16	6.12	24.2%	33.9%
320		8	20.5	13.9	27.1	9.4	32.9	2.8	7.92	38.6%	46.4%

Mean Weight Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.574	0.343	0.804	0.239	1	0.0974	0.275	48.0%	0.0%
20		8	0.57	0.452	0.688	0.366	0.814	0.0499	0.141	24.7%	0.58%
40		8	0.513	0.419	0.607	0.301	0.638	0.0398	0.113	21.9%	10.5%
80		8	0.48	0.433	0.526	0.355	0.541	0.0197	0.0557	11.6%	16.3%
160		8	0.243	0.17	0.316	0.165	0.433	0.0308	0.087	35.8%	57.7%
320		8	0.167	0.0887	0.246	0.0588	0.335	0.0332	0.094	56.2%	70.8%

Percent Emerged Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.984	0.947	1	0.875	1	0.0156	0.0442	4.49%	0.0%
20		8	1	1	1	1	1	0	0	0.0%	-1.59%
40		8	0.984	0.947	1	0.875	1	0.0156	0.0442	4.49%	0.0%
80		8	1	1	1	1	1	0	0	0.0%	-1.59%
160		8	0.984	0.947	1	0.875	1	0.0156	0.0442	4.49%	0.0%
320		8	1	1	1	1	1	0	0	0.0%	-1.59%

Percent Survived Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.984	0.947	1	0.875	1	0.0156	0.0442	4.49%	0.0%
20		8	1	1	1	1	1	0	0	0.0%	-1.59%
40		8	0.984	0.947	1	0.875	1	0.0156	0.0442	4.49%	0.0%
80		8	1	1	1	1	1	0	0	0.0%	-1.59%
160		8	0.984	0.947	1	0.875	1	0.0156	0.0442	4.49%	0.0%
320		8	0.984	0.947	1	0.875	1	0.0156	0.0442	4.49%	0.0%

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Mean Height Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	32.3	41.6	37.8	40.9	38.4	41.3	38	36.1
20		31.1	40.8	36.4	40.4	36.1	41.3	40.6	40.4
40		38.1	36.6	40.6	39	34.4	35.3	42.9	40.5
80		43.1	33.3	34.6	27.3	25.5	32.8	33.9	37.8
160		31.6	22.4	36.6	22.1	19.9	19.1	27.4	23.3
320		24	9.4	27	10.8	18.9	32.9	22.9	18.3

Mean Weight Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	0.239	0.471	0.35	0.906	0.369	1	0.714	0.536
20		0.366	0.814	0.494	0.638	0.561	0.566	0.68	0.444
40		0.301	0.423	0.574	0.551	0.638	0.604	0.566	0.45
80		0.486	0.481	0.464	0.355	0.514	0.509	0.489	0.541
160		0.295	0.185	0.433	0.206	0.195	0.165	0.255	0.21
320		0.199	0.0638	0.256	0.0588	0.153	0.335	0.148	0.126

Percent Emerged Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	1	0.875	1	1	1	1	1	1
20		1	1	1	1	1	1	1	1
40		0.875	1	1	1	1	1	1	1
80		1	1	1	1	1	1	1	1
160		1	1	1	0.875	1	1	1	1
320		1	1	1	1	1	1	1	1

Percent Survived Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	1	0.875	1	1	1	1	1	1
20		1	1	1	1	1	1	1	1
40		0.875	1	1	1	1	1	1	1
80		1	1	1	1	1	1	1	1
160		1	1	1	0.875	1	1	1	1
320		1	1	1	1	1	1	1	0.875

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Batch ID:	02-8920-5996	**Test Type:**	Seedling Emergence Tier II	**Analyst:**	
Start Date:	27 Sep-13	**Protocol:**	OCSPP 850.4100 Plant Seedling Emergen	**Diluent:**	
Ending Date:	20 Apr-15 16:39	**Species:**	Cucumis sativus	**Brine:**	
Duration:	570d 17h	**Source:**	Burpee	**Age:**	

Sample ID:	07-2761-3087	**Code:**	49300301 cucumb	**Client:**	EPA OCSPP EFED
Sample Date:	27 Sep-13	**Material:**	Copper hydroxide	**Project:**	
Receive Date:	20 Apr-15 16:39	**Source:**	Copper Sulfate Task Force, Valdosta, GA		
Sample Age:	NA	**Station:**			

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
17-1865-6536	Mean Height	40	80	56.57	11.0%		Dunnett Multiple Comparison Test
02-0646-2081	Mean Height	40	80	56.57	8.59%		Williams Multiple Comparison Test
11-6795-1959	Mean Weight	40	80	56.57	NA		Jonckheere-Terpstra Step-Down Test
11-7115-6021	Mean Weight	40	80	56.57	8.6%		Mann-Whitney U Two-Sample Test
03-6597-2439	Percent Emerged	320	>320	NA	4.6%		Mann-Whitney U Two-Sample Test
20-4088-0752	Percent Survived	320	>320	NA	4.6%		Mann-Whitney U Two-Sample Test

Point Estimate Summary

Analysis ID	Endpoint	Level		95% LCL	95% UCL	TU	Method
11-7910-5942	Mean Height	IC5	28.4	N/A	43.1		Nonlinear Regression
		IC10	39.8	23.8	53.3		
		IC25	70.1	54.6	86.6		
		IC50	131	114	152		
00-3614-6798	Mean Weight	IC5	24.4	N/A	38.5		Nonlinear Regression
		IC10	37	22.7	50.3		
		IC25	73.7	57.7	91.3		
		IC50	159	139	182		
12-7984-5576	Percent Emerged	EC5	2220	N/A	N/A		Linear Regression (MLE)
		EC10	43400	N/A	N/A		
		EC25	6230000	N/A	N/A		
		EC50	15500000	N/A	N/A		
18-1944-8085	Percent Survived	EC5	2220	N/A	N/A		Linear Regression (MLE)
		EC10	43400	N/A	N/A		
		EC25	6230000	N/A	N/A		
		EC50	15500000	N/A	N/A		

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Mean Height Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	10.6	10.1	11.1	9.5	11.3	0.208	0.587	5.55%	0.0%
20		8	10.6	9.82	11.4	8.8	11.4	0.331	0.937	8.84%	-0.24%
40		8	10.8	9.9	11.7	8.8	11.8	0.389	1.1	10.2%	-2.36%
80		8	9.15	7.92	10.4	6.3	11.3	0.521	1.47	16.1%	13.5%
160		8	2.85	2.07	3.63	1.8	4.5	0.331	0.937	32.9%	73.0%
320		8	2.5	1.84	3.16	1.7	4	0.28	0.791	31.6%	76.4%

Mean Weight Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.146	0.137	0.155	0.132	0.168	0.00396	0.0112	7.67%	0.0%
20		8	0.149	0.137	0.161	0.135	0.182	0.00505	0.0143	9.56%	-2.31%
40		8	0.139	0.131	0.146	0.127	0.153	0.00313	0.00885	6.38%	4.99%
80		8	0.125	0.112	0.138	0.103	0.15	0.00558	0.0158	12.7%	14.6%
160		8	0.0568	0.0403	0.0732	0.04	0.1	0.00697	0.0197	34.7%	61.1%
320		8	0.0478	0.0368	0.0588	0.0333	0.0733	0.00466	0.0132	27.6%	67.3%

Percent Emerged Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	1	1	1	1	1	0	0	0.0%	0.0%
20		8	0.979	0.93	1	0.833	1	0.0208	0.0589	6.02%	2.08%
40		8	1	1	1	1	1	0	0	0.0%	0.0%
80		8	0.979	0.93	1	0.833	1	0.0208	0.0589	6.02%	2.08%
160		8	0.958	0.894	1	0.833	1	0.0273	0.0772	8.05%	4.17%
320		8	0.979	0.93	1	0.833	1	0.0208	0.0589	6.02%	2.08%

Percent Survived Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	1	1	1	1	1	0	0	0.0%	0.0%
20		8	0.979	0.93	1	0.833	1	0.0208	0.0589	6.02%	2.08%
40		8	1	1	1	1	1	0	0	0.0%	0.0%
80		8	0.979	0.93	1	0.833	1	0.0208	0.0589	6.02%	2.08%
160		8	0.958	0.894	1	0.833	1	0.0273	0.0772	8.05%	4.17%
320		8	0.979	0.93	1	0.833	1	0.0208	0.0589	6.02%	2.08%

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Mean Height Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	9.5	11.2	10.3	11	10.5	11.3	10.3	10.5
20		11	9.5	11.4	11	11.2	8.8	11.2	10.7
40		9.5	11.8	11.2	8.8	10.8	11.5	11.8	11.2
80		6.3	9	11.3	8	9.5	9.5	9.8	9.8
160		4	2.5	2.5	2.7	1.8	4.5	2.8	2
320		2.5	3	4	1.7	2	3	1.8	2

Mean Weight Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	0.135	0.142	0.147	0.145	0.132	0.15	0.15	0.168
20		0.148	0.143	0.135	0.182	0.147	0.14	0.147	0.153
40		0.133	0.135	0.137	0.127	0.15	0.14	0.135	0.153
80		0.103	0.122	0.145	0.115	0.126	0.123	0.113	0.15
160		0.064	0.05	0.0433	0.0567	0.04	0.1	0.06	0.04
320		0.045	0.0483	0.0733	0.0333	0.035	0.06	0.0433	0.044

Percent Emerged Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	1	1	1	1	1	1	1	1
20		1	1	1	0.833	1	1	1	1
40		1	1	1	1	1	1	1	1
80		1	1	1	1	0.833	1	1	1
160		0.833	1	1	1	1	1	1	0.833
320		1	1	1	1	1	1	1	0.833

Percent Survived Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	1	1	1	1	1	1	1	1
20		1	1	1	0.833	1	1	1	1
40		1	1	1	1	1	1	1	1
80		1	1	1	1	0.833	1	1	1
160		0.833	1	1	1	1	1	1	0.833
320		1	1	1	1	1	1	1	0.833

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Batch ID:	09-6912-7365	**Test Type:**	Seedling Emergence Tier II	**Analyst:**	
Start Date:	27 Sep-13	**Protocol:**	OCSPP 850.4100 Plant Seedling Emergen	**Diluent:**	
Ending Date:	20 Apr-15 16:36	**Species:**	Ipomoea hederacea	**Brine:**	
Duration:	570d 17h	**Source:**	Field Collected	**Age:**	

Sample ID:	21-4414-6020	**Code:**	49300301 mornin	**Client:**	EPA OCSPP EFED
Sample Date:	27 Sep-13	**Material:**	Copper hydroxide	**Project:**	
Receive Date:	20 Apr-15 16:36	**Source:**	Copper Sulfate Task Force, Valdosta, GA		
Sample Age:	NA	**Station:**			

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
08-0161-1242	Mean Height	<20	20	NA	11.5%		Dunnett Multiple Comparison Test
14-6071-5349	Mean Height	<20	20	NA	8.99%		Williams Multiple Comparison Test
02-8783-0259	Mean Weight	40	80	56.57	NA		Jonckheere-Terpstra Step-Down Test
11-2253-2300	Mean Weight	40	80	56.57	15.0%		Mann-Whitney U Two-Sample Test
09-8157-7633	Percent Emerged	320	>320	NA	10.3%		Mann-Whitney U Two-Sample Test
04-0223-6767	Percent Survived	320	>320	NA	11.0%		Mann-Whitney U Two-Sample Test

Point Estimate Summary

Analysis ID	Endpoint	Level		95% LCL	95% UCL	TU	Method
01-8566-2203	Mean Height	IC5	15	N/A	24		Nonlinear Regression
		IC10	23.5	15.4	31.5		
		IC25	49.7	40.4	59.7		
		IC50	114	101	128		
15-9695-2172	Mean Weight	IC5	26.2	N/A	42.8		Nonlinear Regression
		IC10	39.1	21.6	55.1		
		IC25	76.4	57.4	97.3		
		IC50	161	138	188		
11-5461-1316	Percent Emerged	EC5	100	N/A	N/A		Linear Regression (MLE)
		EC10	25.5	N/A	N/A		
		EC25	2.61	N/A	N/A		
		EC50	0.207	N/A	N/A		
13-8038-3030	Percent Survived	EC5	353	N/A	N/A		Linear Regression (MLE)
		EC10	21.8	N/A	N/A		
		EC25	0.206	N/A	N/A		
		EC50	0.00117	N/A	N/A		

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Mean Height Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	11	10.1	12	9.8	13.3	0.389	1.1	9.96%	0.0%
20		8	9.75	8.7	10.8	7.6	11.5	0.444	1.26	12.9%	11.7%
40		8	8.94	7.76	10.1	6.8	10.8	0.498	1.41	15.8%	19.0%
80		8	7.25	6.26	8.24	4.8	8.7	0.417	1.18	16.3%	34.3%
160		8	3.69	2.93	4.45	2.4	5.6	0.322	0.911	24.7%	66.6%
320		8	2.4	1.95	2.85	1.7	3	0.19	0.537	22.4%	78.3%

Mean Weight Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.15	0.135	0.165	0.123	0.174	0.00629	0.0178	11.9%	0.0%
20		8	0.168	0.133	0.203	0.123	0.235	0.0149	0.0421	25.1%	-12.1%
40		8	0.156	0.129	0.182	0.115	0.194	0.0113	0.0319	20.5%	-3.92%
80		8	0.123	0.103	0.143	0.0967	0.17	0.00846	0.0239	19.5%	18.0%
160		8	0.069	0.0604	0.0775	0.054	0.08	0.00361	0.0102	14.8%	54.0%
320		8	0.049	0.0407	0.0573	0.0333	0.064	0.00353	0.00997	20.4%	67.3%

Percent Emerged Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.875	0.751	0.999	0.667	1	0.0522	0.148	16.9%	0.0%
20		8	0.917	0.811	1	0.667	1	0.0445	0.126	13.7%	-4.76%
40		8	0.875	0.776	0.974	0.667	1	0.0417	0.118	13.5%	0.0%
80		8	0.979	0.93	1	0.833	1	0.0208	0.0589	6.02%	-11.9%
160		8	0.917	0.842	0.991	0.833	1	0.0315	0.0891	9.72%	-4.76%
320		8	1	1	1	1	1	0	0	0.0%	-14.3%

Percent Survived Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.875	0.751	0.999	0.667	1	0.0522	0.148	16.9%	0.0%
20		8	0.917	0.811	1	0.667	1	0.0445	0.126	13.7%	-4.76%
40		8	0.875	0.776	0.974	0.667	1	0.0417	0.118	13.5%	0.0%
80		8	0.958	0.894	1	0.833	1	0.0273	0.0772	8.05%	-9.52%
160		8	0.917	0.842	0.991	0.833	1	0.0315	0.0891	9.72%	-4.76%
320		8	0.958	0.894	1	0.833	1	0.0273	0.0772	8.05%	-9.52%

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Mean Height Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	10.8	10.3	11.2	9.8	13.3	11.8	10.3	10.8
20		9.8	7.6	11.5	9	9.3	10.6	9.2	11
40		6.8	8.5	10.8	9	7.4	10.2	8.6	10.2
80		7.7	7	7.5	4.8	6.8	7.2	8.3	8.7
160		5.6	4	3.7	3.2	2.4	3.6	3.3	3.7
320		3	2.2	3	2.3	2.2	1.7	3	1.8

Mean Weight Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	0.123	0.148	0.13	0.17	0.143	0.174	0.153	0.158
20		0.123	0.126	0.178	0.235	0.127	0.17	0.168	0.217
40		0.115	0.115	0.194	0.188	0.152	0.188	0.142	0.152
80		0.0967	0.105	0.11	0.17	0.11	0.128	0.143	0.12
160		0.08	0.0717	0.0783	0.058	0.054	0.078	0.0717	0.06
320		0.055	0.0417	0.058	0.0483	0.05	0.0333	0.064	0.0417

Percent Emerged Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	1	0.667	1	0.833	1	0.833	0.667	1
20		1	0.833	1	0.667	1	0.833	1	1
40		0.667	1	0.833	0.833	0.833	1	0.833	1
80		1	1	1	0.833	1	1	1	1
160		0.833	1	1	0.833	0.833	0.833	1	1
320		1	1	1	1	1	1	1	1

Percent Survived Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	1	0.667	1	0.833	1	0.833	0.667	1
20		1	0.833	1	0.667	1	0.833	1	1
40		0.667	1	0.833	0.833	0.833	1	0.833	1
80		1	1	1	0.833	1	0.833	1	1
160		0.833	1	1	0.833	0.833	0.833	1	1
320		1	1	0.833	1	1	1	0.833	1

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Batch ID:	06-4866-4319	**Test Type:**	Seedling Emergence Tier II	**Analyst:**	
Start Date:	27 Sep-13	**Protocol:**	OCSPP 850.4100 Plant Seedling Emergen	**Diluent:**	
Ending Date:	20 Apr-15 16:33	**Species:**	Avena sativa	**Brine:**	
Duration:	570d 17h	**Source:**	BWI Companies	**Age:**	

Sample ID:	19-1264-8064	**Code:**	49300301 oat	**Client:**	EPA OCSPP EFED
Sample Date:	27 Sep-13	**Material:**	Copper hydroxide	**Project:**	
Receive Date:	20 Apr-15 16:33	**Source:**	Copper Sulfate Task Force, Valdosta, GA		
Sample Age:	NA	**Station:**			

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
09-3815-5842	Mean Height	40	80	56.57	11.4%		Dunnett Multiple Comparison Test
19-5565-2392	Mean Height	20	40	28.28	8.89%		Williams Multiple Comparison Test
12-1584-0390	Mean Weight	20	40	28.28	NA		Jonckheere-Terpstra Step-Down Test
10-4098-6508	Mean Weight	20	40	28.28	12.2%		Mann-Whitney U Two-Sample Test
04-8701-9397	Percent Emerged	20	40	28.28	7.64%		Mann-Whitney U Two-Sample Test
16-9734-2298	Percent Survived	20	40	28.28	9.23%		Mann-Whitney U Two-Sample Test

Point Estimate Summary

Analysis ID	Endpoint	Level		95% LCL	95% UCL	TU	Method
00-7378-9640	Mean Height	IC5	15.1	3.18	26.2		Nonlinear Regression
		IC10	27.5	16.8	39.1		
		IC25	74.6	59.2	92.2		
		IC50	227	194	265		
01-1998-1490	Mean Weight	IC5	12.1	N/A	24.8		Nonlinear Regression
		IC10	20.8	9.42	32.8		
		IC25	51.1	36.8	67.9		
		IC50	139	116	166		
14-7093-5132	Percent Emerged	EC5	18.1	N/A	N/A		Linear Regression (MLE)
		EC10	2820	N/A	N/A		
		EC25	13000000	N/A	N/A		
		EC50	15200000	N/A	N/A		
21-0089-1152	Percent Survived	EC5	3.39	N/A	N/A		Linear Regression (MLE)
		EC10	4890	N/A	N/A		
		EC25	93100000	N/A	N/A		
		EC50	68400000	N/A	N/A		

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Mean Height Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	29.4	27.8	31	27.8	33.8	0.675	1.91	6.5%	0.0%
20		8	28.5	26.5	30.5	24.3	31	0.849	2.4	8.42%	3.02%
40		8	26.5	24.7	28.4	23	30.4	0.772	2.18	8.23%	9.7%
80		8	21.3	18.1	24.4	17.7	27.6	1.34	3.8	17.9%	27.7%
160		8	16.9	13.2	20.6	12.3	25	1.57	4.43	26.2%	42.4%
320		8	12.9	11.7	14.2	10.9	15	0.536	1.52	11.7%	56.0%

Mean Weight Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.0528	0.0485	0.0572	0.0463	0.0638	0.00184	0.00521	9.86%	0.0%
20		8	0.0508	0.0472	0.0544	0.0425	0.055	0.00151	0.00428	8.42%	3.85%
40		8	0.0468	0.0407	0.0529	0.0343	0.06	0.00258	0.0073	15.6%	11.4%
80		8	0.0326	0.0242	0.041	0.02	0.0475	0.00356	0.0101	30.8%	38.3%
160		8	0.0234	0.0144	0.0323	0.0129	0.042	0.00378	0.0107	45.8%	55.7%
320		8	0.017	0.015	0.0189	0.0138	0.02	0.000827	0.00234	13.8%	67.9%

Percent Emerged Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	1	1	1	1	1	0	0	0.0%	0.0%
20		8	0.938	0.826	1	0.625	1	0.0472	0.134	14.3%	6.25%
40		8	0.938	0.882	0.993	0.875	1	0.0236	0.0668	7.13%	6.25%
80		8	0.984	0.947	1	0.875	1	0.0156	0.0442	4.49%	1.56%
160		8	0.906	0.814	0.999	0.75	1	0.0392	0.111	12.2%	9.38%
320		8	0.922	0.844	1	0.75	1	0.0329	0.093	10.1%	7.81%

Percent Survived Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	1	1	1	1	1	0	0	0.0%	0.0%
20		8	0.922	0.775	1	0.5	1	0.0622	0.176	19.1%	7.81%
40		8	0.938	0.882	0.993	0.875	1	0.0236	0.0668	7.13%	6.25%
80		8	0.984	0.947	1	0.875	1	0.0156	0.0442	4.49%	1.56%
160		8	0.891	0.773	1	0.625	1	0.0498	0.141	15.8%	10.9%
320		8	0.922	0.844	1	0.75	1	0.0329	0.093	10.1%	7.81%

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Mean Height Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	27.8	29.5	29.5	29.5	28.4	33.8	28.6	28
20		26.1	27.9	31	27.9	30.9	29.9	30	24.3
40		23	27.4	24.6	26.6	27.6	26	26.7	30.4
80		18	27.6	20.6	17.7	20.9	17.9	21	26.3
160		20.4	16.4	25	19.8	14.6	12.3	14.3	12.7
320		10.9	12.6	13.4	12	14.8	11.3	13.5	15

Mean Weight Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	0.0525	0.0513	0.0488	0.0538	0.055	0.0638	0.0513	0.0463
20		0.05	0.05	0.055	0.0488	0.055	0.055	0.05	0.0425
40		0.0343	0.045	0.0429	0.045	0.05	0.05	0.0471	0.06
80		0.0225	0.0463	0.0313	0.0271	0.035	0.02	0.0313	0.0475
160		0.0325	0.0225	0.042	0.0313	0.015	0.0129	0.0167	0.0143
320		0.015	0.0143	0.0188	0.0171	0.02	0.0138	0.0183	0.0186

Percent Emerged Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	1	1	1	1	1	1	1	1
20		1	1	1	1	1	1	0.875	0.625
40		0.875	1	0.875	1	1	0.875	0.875	1
80		1	1	1	0.875	1	1	1	1
160		1	1	0.75	1	1	0.875	0.75	0.875
320		1	0.875	1	0.875	1	1	0.75	0.875

Percent Survived Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	1	1	1	1	1	1	1	1
20		1	1	1	1	1	1	0.875	0.5
40		0.875	1	0.875	1	1	0.875	0.875	1
80		1	1	1	0.875	1	1	1	1
160		1	1	0.625	1	1	0.875	0.75	0.875
320		1	0.875	1	0.875	1	1	0.75	0.875

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Batch ID:	01-5551-4562	**Test Type:**	Seedling Emergence Tier II	**Analyst:**	
Start Date:	27 Sep-13	**Protocol:**	OCSPP 850.4100 Plant Seedling Emergen	**Diluent:**	
Ending Date:	20 Apr-15 16:35	**Species:**	Allium cepa	**Brine:**	
Duration:	570d 17h	**Source:**	Burpee	**Age:**	

Sample ID:	21-0380-0937	**Code:**	49300301 onion	**Client:**	EPA OCSPP EFED
Sample Date:	27 Sep-13	**Material:**	Copper hydroxide	**Project:**	
Receive Date:	20 Apr-15 16:35	**Source:**	Copper Sulfate Task Force, Valdosta, GA		
Sample Age:	NA	**Station:**			

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
21-4507-4947	Mean Height	20	40	28.28	12.8%		Dunnett Multiple Comparison Test
08-2333-9999	Mean Height	20	40	28.28	10.1%		Williams Multiple Comparison Test
04-6119-4909	Mean Weight	20	40	28.28	22.3%		Dunnett Multiple Comparison Test
02-9022-6117	Mean Weight	20	40	28.28	17.4%		Williams Multiple Comparison Test
00-8059-5361	Percent Emerged	320	>320	NA	23.3%		Dunnett Multiple Comparison Test
09-2086-6226	Percent Survived	320	>320	NA	23.3%		Dunnett Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level		95% LCL	95% UCL	TU	Method
11-8066-3954	Mean Height	IC5	7.11	N/A	22.9		Nonlinear Regression
		IC10	20.2	6.17	43.5		
		IC25	116	79.2	165		
		IC50	809	349	1870		
06-1301-0808	Mean Weight	IC5	5.75	N/A	22.1		Nonlinear Regression
		IC10	12	N/A	29.7		
		IC25	40.9	21.3	69.7		
		IC50	160	113	226		
21-0296-9941	Percent Emerged	EC5	0.000229	N/A	N/A		Linear Regression (MLE)
		EC10	0.0186	N/A	N/A		
		EC25	29	N/A	N/A		
		EC50	102000	N/A	N/A		
18-5932-0190	Percent Survived	EC5	0.0000284	N/A	N/A		Linear Regression (MLE)
		EC10	0.00352	N/A	N/A		
		EC25	11.1	N/A	N/A		
		EC50	86000	N/A	N/A		

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Mean Height Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	10	8.52	8.17	8.87	7.4	9	0.154	0.487	5.72%	0.0%
20		10	8.93	8.23	9.63	6.5	10	0.308	0.975	10.9%	-4.81%
40		10	6.85	5.82	7.88	5.3	9.7	0.457	1.45	21.1%	19.6%
80		10	6.44	5.67	7.21	4.8	7.9	0.342	1.08	16.8%	24.4%
160		10	6.2	5.28	7.12	4.8	8.5	0.409	1.29	20.8%	27.2%
320		10	5.69	5.08	6.3	4.2	7.2	0.272	0.86	15.1%	33.2%

Mean Weight Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	10	0.00705	0.00613	0.00797	0.00525	0.00911	0.000407	0.00129	18.3%	0.0%
20		10	0.00845	0.00695	0.00995	0.00381	0.0106	0.000664	0.0021	24.9%	-19.9%
40		10	0.00474	0.00336	0.00611	0.00159	0.00808	0.000608	0.00192	40.6%	32.8%
80		10	0.00408	0.00339	0.00477	0.00302	0.00589	0.000305	0.000964	23.6%	42.1%
160		10	0.00362	0.00244	0.0048	0.00133	0.00637	0.000521	0.00165	45.5%	48.6%
320		10	0.00319	0.0026	0.00377	0.00185	0.00436	0.000258	0.000816	25.6%	54.8%

Percent Emerged Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	10	0.74	0.663	0.817	0.6	0.9	0.034	0.107	14.5%	0.0%
20		10	0.79	0.686	0.894	0.6	1	0.0458	0.145	18.3%	-6.76%
40		10	0.72	0.574	0.866	0.3	1	0.0646	0.204	28.4%	2.7%
80		10	0.69	0.566	0.814	0.4	1	0.0547	0.173	25.1%	6.76%
160		10	0.71	0.577	0.843	0.4	1	0.0586	0.185	26.1%	4.05%
320		10	0.7	0.574	0.826	0.5	1	0.0558	0.176	25.2%	5.41%

Percent Survived Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	10	0.74	0.663	0.817	0.6	0.9	0.034	0.107	14.5%	0.0%
20		10	0.77	0.663	0.877	0.5	1	0.0473	0.149	19.4%	-4.05%
40		10	0.69	0.562	0.818	0.3	0.9	0.0567	0.179	26.0%	6.76%
80		10	0.66	0.524	0.796	0.4	1	0.06	0.19	28.7%	10.8%
160		10	0.71	0.577	0.843	0.4	1	0.0586	0.185	26.1%	4.05%
320		10	0.67	0.539	0.801	0.5	1	0.0578	0.183	27.3%	9.46%

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Mean Height Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	8.3	8.7	9	8.6	8.5	8.1	7.4	8.8	8.8	9
20		9.4	9.9	10	9.1	8.6	9.1	8.9	6.5	8.6	9.2
40		5.3	9.7	5.5	6.1	6.2	8.1	6.5	6.3	8.6	6.2
80		7.4	7.5	6.3	5.8	7.9	6.8	4.8	6.1	7	4.8
160		5.8	6.3	7.3	7.9	8.5	5.3	5	5.1	6	4.8
320		5.6	7.2	6	5.6	6.8	4.2	4.9	5.4	5.4	5.8

Mean Weight Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	0.00569	0.00525	0.0076	0.00553	0.00773	0.00829	0.0066	0.00786	0.00679	0.00911
20		0.0105	0.00795	0.0106	0.00893	0.00696	0.00713	0.00868	0.00381	0.00969	0.0102
40		0.00159	0.00563	0.00265	0.00386	0.00432	0.00691	0.00572	0.00437	0.00808	0.00424
80		0.0031	0.00476	0.0037	0.00325	0.00589	0.00492	0.0039	0.00345	0.00483	0.00302
160		0.00238	0.00381	0.00382	0.00591	0.00637	0.00303	0.00133	0.00229	0.0048	0.00249
320		0.00338	0.00436	0.00387	0.00316	0.00432	0.00185	0.00254	0.00308	0.00252	0.00278

Percent Emerged Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	0.7	0.6	0.7	0.9	0.6	0.7	0.9	0.8	0.8	0.7
20		0.8	0.8	0.6	0.7	0.9	0.7	0.8	1	1	0.6
40		0.8	0.3	0.6	0.9	0.6	0.7	0.6	0.8	0.9	1
80		0.8	0.8	0.6	0.6	0.8	0.4	0.5	1	0.7	0.7
160		0.6	0.8	1	0.7	0.6	0.6	0.7	0.7	0.4	1
320		0.5	0.5	0.7	0.9	0.5	1	0.7	0.8	0.8	0.6

Percent Survived Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	0.7	0.6	0.7	0.9	0.6	0.7	0.9	0.8	0.8	0.7
20		0.8	0.8	0.5	0.7	0.9	0.7	0.8	1	0.9	0.6
40		0.8	0.3	0.6	0.9	0.6	0.7	0.6	0.7	0.8	0.9
80		0.8	0.8	0.6	0.6	0.8	0.4	0.4	1	0.6	0.6
160		0.6	0.8	1	0.7	0.6	0.6	0.7	0.7	0.4	1
320		0.5	0.5	0.7	0.9	0.5	1	0.7	0.8	0.5	0.6

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) — **Landis International, Inc.**

Batch ID:	10-6398-9435	**Test Type:**	Seedling Emergence Tier II	**Analyst:**	
Start Date:	27 Sep-13	**Protocol:**	OCSPP 850.4100 Plant Seedling Emergen	**Diluent:**	
Ending Date:	20 Apr-15 16:38	**Species:**	Raphanus sativus	**Brine:**	
Duration:	570d 17h	**Source:**	Ferry-Morse Meyer Seed Co	**Age:**	

Sample ID:	19-7166-0425	**Code:**	49300301 radish	**Client:**	EPA OCSPP EFED
Sample Date:	27 Sep-13	**Material:**	Copper hydroxide	**Project:**	
Receive Date:	20 Apr-15 16:38	**Source:**	Copper Sulfate Task Force, Valdosta, GA		
Sample Age:	NA	**Station:**			

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
06-2733-8231	Mean Height	20	40	28.28	9.29%		Dunnett Multiple Comparison Test
16-2797-3181	Mean Height	20	40	28.28	7.23%		Williams Multiple Comparison Test
06-7630-8755	Mean Weight	<20	20	NA	11.4%		Dunnett Multiple Comparison Test
14-1399-7828	Mean Weight	<20	20	NA	8.9%		Williams Multiple Comparison Test
20-9123-3659	Percent Emerged	40	80	56.57	NA		Jonckheere-Terpstra Step-Down Test
01-3055-0732	Percent Emerged	40	80	56.57	16.0%		Mann-Whitney U Two-Sample Test
06-4195-1561	Percent Survived	80	160	113.1	20.3%		Dunnett Multiple Comparison Test
05-7337-7084	Percent Survived	40	80	56.57	15.9%		Williams Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level		95% LCL	95% UCL	TU	Method
01-0294-0636	Mean Height	IC5	4.04	N/A	10.3		Nonlinear Regression
		IC10	7.19	1.77	13.2		
		IC25	18.8	12.4	26.8		
		IC50	54.9	44.6	67.6		
06-4209-5792	Mean Weight	IC5	3.17	N/A	8.94		Nonlinear Regression
		IC10	5.55	N/A	11.2		
		IC25	14.1	8.44	21.4		
		IC50	39.9	30.9	51.4		
10-6117-4790	Percent Emerged	EC5	19.7	9.3	30.8		Linear Regression (MLE)
		EC10	33	18.7	46.8		
		EC25	77.6	56.5	100		
		EC50	201	152	297		
07-5083-4301	Percent Emerged	EC50	202	80.2	506		Trimmed Spearman-Kärber
12-3645-8872	Percent Survived	EC5	18.9	8.87	29.6		Linear Regression (MLE)
		EC10	31.6	17.8	45		
		EC25	74.3	53.9	96.2		
		EC50	193	147	282		
19-7894-1108	Percent Survived	EC50	196	98.7	389		Trimmed Spearman-Kärber

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Mean Height Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	10.8	10.2	11.3	9.5	11.6	0.247	0.699	6.5%	0.0%
20		8	10.3	9.79	10.7	9	10.8	0.193	0.545	5.32%	4.65%
40		8	6.66	5.76	7.57	5.5	8.2	0.382	1.08	16.2%	38.0%
80		8	2.98	2.41	3.54	1.8	4	0.238	0.673	22.6%	72.3%
160		8	2.7	1.77	3.63	1.5	4.3	0.393	1.11	41.2%	74.9%
320		7	2.17	1.51	2.84	1.2	3.5	0.272	0.72	33.2%	79.8%

Mean Weight Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.0845	0.0747	0.0943	0.07	0.104	0.00413	0.0117	13.8%	0.0%
20		8	0.0727	0.0657	0.0798	0.0567	0.0825	0.00298	0.00843	11.6%	13.9%
40		8	0.0441	0.0383	0.0499	0.03	0.0517	0.00245	0.00693	15.7%	47.8%
80		8	0.0151	0.0112	0.0191	0.006	0.0233	0.00166	0.00471	31.1%	82.1%
160		8	0.0181	0.0115	0.0247	0.005	0.025	0.00279	0.00788	43.5%	78.6%
320		7	0.0113	0.00471	0.0179	0.0025	0.025	0.0027	0.00713	63.1%	86.6%

Percent Emerged Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.938	0.865	1	0.833	1	0.0305	0.0863	9.2%	0.0%
20		8	0.917	0.811	1	0.667	1	0.0445	0.126	13.7%	2.22%
40		8	0.938	0.865	1	0.833	1	0.0305	0.0863	9.2%	0.0%
80		8	0.75	0.621	0.879	0.5	1	0.0546	0.154	20.6%	20.0%
160		8	0.5	0.351	0.649	0.333	0.667	0.063	0.178	35.6%	46.7%
320		8	0.396	0.15	0.642	0	0.833	0.104	0.295	74.4%	57.8%

Percent Survived Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.938	0.865	1	0.833	1	0.0305	0.0863	9.2%	0.0%
20		8	0.917	0.811	1	0.667	1	0.0445	0.126	13.7%	2.22%
40		8	0.917	0.842	0.991	0.833	1	0.0315	0.0891	9.72%	2.22%
80		8	0.75	0.621	0.879	0.5	1	0.0546	0.154	20.6%	20.0%
160		8	0.5	0.351	0.649	0.333	0.667	0.063	0.178	35.6%	46.7%
320		8	0.375	0.142	0.608	0	0.833	0.0983	0.278	74.2%	60.0%

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Mean Height Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	10	11.3	10.7	11.6	9.5	11.2	11	10.7
20		10.2	10.5	10.4	10.3	10.2	9	10.6	10.8
40		5.6	7.6	6.6	5.5	7.7	5.5	8.2	6.6
80		4	3.5	2.8	2.4	3	3	3.3	1.8
160		1.5	1.5	3	2.5	2	4.3	2.5	4.3
320		1.2	2.5		2.3	1.7	2	2	3.5

Mean Weight Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	0.076	0.0983	0.085	0.104	0.07	0.086	0.0817	0.075
20		0.0667	0.0825	0.078	0.0783	0.0683	0.0567	0.078	0.0733
40		0.044	0.05	0.042	0.0467	0.0517	0.03	0.0483	0.04
80		0.0233	0.015	0.014	0.016	0.015	0.015	0.0167	0.006
160		0.01	0.025	0.02	0.0125	0.025	0.025	0.005	0.0225
320		0.01	0.015		0.0025	0.00667	0.01	0.01	0.025

Percent Emerged Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	0.833	1	1	0.833	1	0.833	1	1
20		1	0.667	0.833	1	1	1	0.833	1
40		0.833	1	0.833	1	1	1	1	0.833
80		0.5	0.667	0.833	0.833	0.667	0.667	1	0.833
160		0.667	0.333	0.333	0.667	0.333	0.667	0.333	0.667
320		0.833	0.333	0	0.667	0.667	0.167	0.167	0.333

Percent Survived Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	0.833	1	1	0.833	1	0.833	1	1
20		1	0.667	0.833	1	1	1	0.833	1
40		0.833	0.833	0.833	1	1	1	1	0.833
80		0.5	0.667	0.833	0.833	0.667	0.667	1	0.833
160		0.667	0.333	0.333	0.667	0.333	0.667	0.333	0.667
320		0.833	0.333	0	0.667	0.5	0.167	0.167	0.333

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Batch ID:	17-5780-4212	**Test Type:**	Seedling Emergence Tier II	**Analyst:**	
Start Date:	27 Sep-13	**Protocol:**	OCSPP 850.4100 Plant Seedling Emergen	**Diluent:**	
Ending Date:	20 Apr-15 16:34	**Species:**	Sorghum bicolor	**Brine:**	
Duration:	570d 17h	**Source:**	Hancock Feed and Seed	**Age:**	

Sample ID:	05-1568-8401	**Code:**	49300301 sorghu	**Client:**	EPA OCSPP EFED
Sample Date:	27 Sep-13	**Material:**	Copper hydroxide	**Project:**	
Receive Date:	20 Apr-15 16:34	**Source:**	Copper Sulfate Task Force, Valdosta, GA		
Sample Age:	NA	**Station:**			

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
00-6252-1758	Mean Height	20	40	28.28	12.8%		Dunnett Multiple Comparison Test
13-1178-7856	Mean Height	<20	20	NA	9.97%		Williams Multiple Comparison Test
02-1890-2353	Mean Weight	20	40	28.28	22.6%		Dunnett Multiple Comparison Test
20-3150-9842	Mean Weight	<20	20	NA	17.7%		Williams Multiple Comparison Test
11-0229-0543	Percent Emerged	320	>320	NA	5.84%		Mann-Whitney U Two-Sample Test
14-2407-0999	Percent Survived	320	>320	NA	6.39%		Mann-Whitney U Two-Sample Test

Point Estimate Summary

Analysis ID	Endpoint	Level		95% LCL	95% UCL	TU	Method
09-6422-5542	Mean Height	IC5	9.9	N/A	18.7		Nonlinear Regression
		IC10	17	9.25	25.2		
		IC25	41.8	32.2	52.9		
		IC50	114	98.5	132		
09-2653-4202	Mean Weight	IC5	9.41	N/A	23.1		Nonlinear Regression
		IC10	15.5	1.89	28		
		IC25	35.6	22.6	51.5		
		IC50	89.7	70.3	114		
15-3736-2279	Percent Emerged	EC5	10.5	N/A	N/A		Linear Regression (MLE)
		EC10	0.00269	N/A	N/A		
		EC25	0.0000000	N/A	N/A		
		EC50	5.8E-16	N/A	N/A		
10-6356-1700	Percent Survived	EC5	41	N/A	N/A		Linear Regression (MLE)
		EC10	0.726	N/A	N/A		
		EC25	0.000858	N/A	N/A		
		EC50	0.0000004	N/A	N/A		

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Mean Height Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	30.8	27.8	33.9	24.3	34.9	1.3	3.67	11.9%	0.0%
20		8	27.3	25.1	29.6	24.6	31.6	0.956	2.7	9.9%	11.4%
40		8	25.2	22.7	27.6	21.3	30.7	1.02	2.88	11.5%	18.4%
80		8	18.3	13.7	22.9	11	25	1.93	5.45	29.8%	40.6%
160		7	11.2	8.83	13.5	6.9	14.3	0.958	2.53	22.7%	63.8%
320		8	8.33	6.69	9.96	5.5	10.9	0.689	1.95	23.4%	73.0%

Mean Weight Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.0998	0.077	0.123	0.0513	0.144	0.00963	0.0272	27.3%	0.0%
20		8	0.0802	0.0677	0.0927	0.06	0.104	0.00529	0.015	18.6%	19.6%
40		8	0.0727	0.0588	0.0867	0.0457	0.0988	0.0059	0.0167	22.9%	27.1%
80		8	0.0554	0.0323	0.0784	0.0163	0.0886	0.00975	0.0276	49.8%	44.5%
160		7	0.0305	0.0177	0.0433	0.015	0.0529	0.00523	0.0138	45.4%	69.4%
320		8	0.0177	0.0107	0.0248	0.00875	0.0313	0.00298	0.00843	47.6%	82.3%

Percent Emerged Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.984	0.947	1	0.875	1	0.0156	0.0442	4.49%	0.0%
20		8	0.969	0.895	1	0.75	1	0.0313	0.0884	9.12%	1.59%
40		8	0.938	0.882	0.993	0.875	1	0.0236	0.0668	7.13%	4.76%
80		8	0.953	0.899	1	0.875	1	0.0229	0.0647	6.79%	3.17%
160		7	0.964	0.908	1	0.875	1	0.0231	0.061	6.33%	2.04%
320		8	0.969	0.92	1	0.875	1	0.0205	0.0579	5.97%	1.59%

Percent Survived Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.953	0.899	1	0.875	1	0.0229	0.0647	6.79%	0.0%
20		8	0.953	0.875	1	0.75	1	0.0329	0.093	9.76%	0.0%
40		8	0.938	0.882	0.993	0.875	1	0.0236	0.0668	7.13%	1.64%
80		8	0.953	0.899	1	0.875	1	0.0229	0.0647	6.79%	0.0%
160		7	0.964	0.908	1	0.875	1	0.0231	0.061	6.33%	-1.17%
320		8	0.969	0.92	1	0.875	1	0.0205	0.0579	5.97%	-1.64%

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Mean Height Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	24.3	31.9	34.4	34.9	30.3	30.3	27.1	33.4
20		24.6	26.4	31.6	31.4	25	26.8	26.8	25.9
40		24.3	22.9	24.9	23.9	21.3	27.3	25.9	30.7
80		22.7	16.3	16	11	11.5	19.9	24	25
160			13.6	9.4	10.9	10.8	14.3	12.3	6.9
320		9.7	5.5	7.9	6.3	6.9	9.6	9.8	10.9

Mean Weight Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	0.0513	0.106	0.144	0.103	0.0814	0.121	0.0929	0.0988
20		0.06	0.0712	0.0975	0.104	0.0683	0.075	0.0875	0.0786
40		0.0686	0.0638	0.09	0.0663	0.0457	0.0814	0.0675	0.0988
80		0.055	0.0486	0.055	0.0163	0.0188	0.075	0.0857	0.0886
160			0.0343	0.0188	0.03	0.02	0.0529	0.0425	0.015
320		0.0188	0.00875	0.0129	0.01	0.0113	0.0313	0.0213	0.0275

Percent Emerged Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	1	1	1	1	0.875	1	1	1
20		1	1	1	1	0.75	1	1	1
40		0.875	1	0.875	1	0.875	0.875	1	1
80		1	0.875	1	1	1	1	0.875	0.875
160			0.875	1	1	1	0.875	1	1
320		1	1	0.875	0.875	1	1	1	1

Percent Survived Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	1	1	1	1	0.875	0.875	0.875	1
20		1	1	1	1	0.75	1	1	0.875
40		0.875	1	0.875	1	0.875	0.875	1	1
80		1	0.875	1	1	1	1	0.875	0.875
160			0.875	1	1	1	0.875	1	1
320		1	1	0.875	0.875	1	1	1	1

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Batch ID:	14-3661-9082	**Test Type:**	Seedling Emergence Tier II	**Analyst:**	
Start Date:	27 Sep-13	**Protocol:**	OCSPP 850.4100 Plant Seedling Emergen	**Diluent:**	
Ending Date:	20 Apr-15 16:37	**Species:**	Glycine max	**Brine:**	
Duration:	570d 17h	**Source:**	Plantation seed	**Age:**	

Sample ID:	04-1790-4875	**Code:**	49300301 soybea	**Client:**	EPA OCSPP EFED
Sample Date:	27 Sep-13	**Material:**	Copper hydroxide	**Project:**	
Receive Date:	20 Apr-15 16:37	**Source:**	Copper Sulfate Task Force, Valdosta, GA		
Sample Age:	NA	**Station:**			

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
10-8372-2396	Mean Height	160	320	226.3	8.19%		Dunnett Multiple Comparison Test
19-2233-0302	Mean Height	160	320	226.3	6.4%		Williams Multiple Comparison Test
17-2399-3032	Mean Weight	<20	20	NA	NA		Jonckheere-Terpstra Step-Down Test
14-3481-0367	Mean Weight	<20	20	NA	12.8%		Mann-Whitney U Two-Sample Test
20-7229-2802	Percent Emerged	320	>320	NA	3.75%		Mann-Whitney U Two-Sample Test
04-4093-7359	Percent Survived	320	>320	NA	3.75%		Mann-Whitney U Two-Sample Test

Point Estimate Summary

Analysis ID	Endpoint	Level		95% LCL	95% UCL	TU	Method
14-2375-2335	Mean Height	IC5	177	N/A	237		Nonlinear Regression
		IC10	233	173	283		
		IC25	370	301	441		
		IC50	619	344	1110		
17-7577-6380	Mean Weight	IC5	0.0366	N/A	3.38		Nonlinear Regression
		IC10	0.444	N/A	14.3		
		IC25	28.8	7.19	97.2		
		IC50	2960	146	59900		
07-3431-6563	Percent Emerged	EC5	0.464	N/A	N/A		Linear Regression (MLE)
		EC10	0.0415	N/A	N/A		
		EC25	0.000733	N/A	N/A		
		EC50	0.0000082	N/A	N/A		
04-6775-1527	Percent Survived	EC5	0.464	N/A	N/A		Linear Regression (MLE)
		EC10	0.0415	N/A	N/A		
		EC25	0.000733	N/A	N/A		
		EC50	0.0000082	N/A	N/A		

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Mean Height Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	17	16.1	18	15.5	18.5	0.392	1.11	6.52%	0.0%
20		8	16.3	15.6	17	15.3	17.8	0.293	0.829	5.08%	4.19%
40		8	16.5	15	18	13.2	18.5	0.637	1.8	10.9%	2.86%
80		8	17.3	16.8	17.9	16.6	18.2	0.215	0.607	3.5%	-1.91%
160		8	16	15	17	14.2	17.7	0.432	1.22	7.63%	6.02%
320		8	13.6	12.5	14.7	11.5	15.2	0.468	1.32	9.76%	20.3%

Mean Weight Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.364	0.281	0.447	0.225	0.55	0.0352	0.0994	27.3%	0.0%
20		8	0.276	0.254	0.298	0.243	0.323	0.00914	0.0259	9.37%	24.2%
40		8	0.262	0.223	0.3	0.203	0.313	0.0162	0.0458	17.5%	28.1%
80		8	0.268	0.245	0.291	0.235	0.305	0.00976	0.0276	10.3%	26.4%
160		8	0.239	0.205	0.274	0.155	0.285	0.0146	0.0413	17.3%	34.2%
320		8	0.225	0.191	0.26	0.165	0.282	0.0146	0.0413	18.3%	38.1%

Percent Emerged Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.979	0.93	1	0.833	1	0.0208	0.0589	6.02%	0.0%
20		8	1	1	1	1	1	0	0	0.0%	-2.13%
40		8	0.979	0.93	1	0.833	1	0.0208	0.0589	6.02%	0.0%
80		8	0.979	0.93	1	0.833	1	0.0208	0.0589	6.02%	0.0%
160		8	1	1	1	1	1	0	0	0.0%	-2.13%
320		8	1	1	1	1	1	0	0	0.0%	-2.13%

Percent Survived Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.979	0.93	1	0.833	1	0.0208	0.0589	6.02%	0.0%
20		8	1	1	1	1	1	0	0	0.0%	-2.13%
40		8	0.979	0.93	1	0.833	1	0.0208	0.0589	6.02%	0.0%
80		8	0.979	0.93	1	0.833	1	0.0208	0.0589	6.02%	0.0%
160		8	1	1	1	1	1	0	0	0.0%	-2.13%
320		8	1	1	1	1	1	0	0	0.0%	-2.13%

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Mean Height Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	17	16.2	18.5	18.2	18	16.8	16	15.5
20		17.8	15.8	16.7	16.2	15.3	16.2	15.5	17
40		15.7	18.3	18.3	13.2	16.4	15.7	18.5	16.2
80		17.5	16.6	16.7	16.8	18.2	18	17.3	17.7
160		15.3	17.7	17	14.7	16.3	17	15.8	14.2
320		14	13.7	14.8	11.8	11.5	14.2	13.3	15.2

Mean Weight Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	0.278	0.225	0.4	0.422	0.55	0.37	0.36	0.307
20		0.273	0.278	0.298	0.28	0.243	0.252	0.26	0.323
40		0.227	0.313	0.31	0.218	0.236	0.203	0.31	0.275
80		0.247	0.302	0.28	0.235	0.235	0.305	0.267	0.273
160		0.235	0.267	0.285	0.155	0.207	0.252	0.265	0.25
320		0.243	0.183	0.233	0.192	0.165	0.282	0.237	0.267

Percent Emerged Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	1	1	1	1	0.833	1	1	1
20		1	1	1	1	1	1	1	1
40		1	1	1	1	0.833	1	1	1
80		1	0.833	1	1	1	1	1	1
160		1	1	1	1	1	1	1	1
320		1	1	1	1	1	1	1	1

Percent Survived Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	1	1	1	1	0.833	1	1	1
20		1	1	1	1	1	1	1	1
40		1	1	1	1	0.833	1	1	1
80		1	0.833	1	1	1	1	1	1
160		1	1	1	1	1	1	1	1
320		1	1	1	1	1	1	1	1

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Batch ID:	08-1865-8601	**Test Type:**	Seedling Emergence Tier II	**Analyst:**	
Start Date:	27 Sep-13	**Protocol:**	OCSPP 850.4100 Plant Seedling Emergen	**Diluent:**	
Ending Date:	20 Apr-15 16:39	**Species:**	Helianthus annuua	**Brine:**	
Duration:	570d 17h	**Source:**	Burpee	**Age:**	

Sample ID:	14-2224-2529	**Code:**	49300301 sunflo	**Client:**	EPA OCSPP EFED
Sample Date:	27 Sep-13	**Material:**	Copper hydroxide	**Project:**	
Receive Date:	20 Apr-15 16:39	**Source:**	Copper Sulfate Task Force, Valdosta, GA		
Sample Age:	NA	**Station:**			

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
16-6116-1189	Mean Height	40	80	56.57	14.5%		Dunnett Multiple Comparison Test
06-7441-4409	Mean Height	40	80	56.57	11.3%		Williams Multiple Comparison Test
13-8027-0893	Mean Weight	20	40	28.28	NA		Jonckheere-Terpstra Step-Down Test
03-3045-3885	Mean Weight	20	40	28.28	23.4%		Mann-Whitney U Two-Sample Test
02-7832-0300	Percent Emerged	320	>320	NA	19.4%		Dunnett Multiple Comparison Test
00-4030-4919	Percent Survived	320	>320	NA	19.3%		Dunnett Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level		95% LCL	95% UCL	TU	Method
01-2112-2268	Mean Height	IC5	6.22	N/A	17.6		Nonlinear Regression
		IC10	13.9	4.38	27.3		
		IC25	53.3	35.3	76.7		
		IC50	237	176	320		
11-1634-4755	Mean Weight	IC5	2.3	N/A	11.9		Nonlinear Regression
		IC10	4.74	N/A	15.1		
		IC25	15.9	6.1	32.5		
		IC50	60.9	41.1	90.4		
13-1038-1164	Percent Emerged	EC5	1.78	N/A	13.3		Linear Regression (MLE)
		EC10	10.7	N/A	36.8		
		EC25	214	86.4	56600000		
		EC50	5970	713	1E+10		
08-9615-9879	Percent Survived	EC5	0.901	N/A	N/A		Linear Regression (MLE)
		EC10	7.08	N/A	N/A		
		EC25	222	N/A	N/A		
		EC50	10200	N/A	N/A		

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Mean Height Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	2.29	1.99	2.58	1.8	3	0.125	0.352	15.4%	0.0%
20		8	2.15	1.87	2.43	1.8	2.6	0.116	0.33	15.3%	6.01%
40		8	2.05	1.77	2.33	1.5	2.6	0.116	0.33	16.1%	10.4%
80		8	1.46	1.23	1.69	1.2	2	0.0962	0.272	18.6%	36.1%
160		8	1.14	1	1.27	1	1.4	0.0565	0.16	14.0%	50.3%
320		8	1.2	1.01	1.39	1	1.5	0.0824	0.233	19.4%	47.5%

Mean Weight Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.112	0.0627	0.162	0.055	0.23	0.0209	0.0592	52.8%	0.0%
20		8	0.092	0.0621	0.122	0.0617	0.157	0.0126	0.0357	38.8%	18.0%
40		8	0.0691	0.057	0.0813	0.05	0.0917	0.00513	0.0145	21.0%	38.4%
80		8	0.0428	0.0338	0.0518	0.026	0.06	0.0038	0.0108	25.1%	61.8%
160		8	0.0294	0.0245	0.0344	0.022	0.038	0.00208	0.00588	20.0%	73.7%
320		8	0.0299	0.0177	0.0422	0.0167	0.0583	0.00516	0.0146	48.8%	73.3%

Percent Emerged Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.833	0.684	0.982	0.5	1	0.063	0.178	21.4%	0.0%
20		8	0.917	0.842	0.991	0.833	1	0.0315	0.0891	9.72%	-10.0%
40		8	0.813	0.696	0.929	0.667	1	0.0492	0.139	17.1%	2.5%
80		8	0.75	0.676	0.824	0.667	0.833	0.0315	0.0891	11.9%	10.0%
160		8	0.813	0.674	0.951	0.5	1	0.0584	0.165	20.3%	2.5%
320		8	0.729	0.602	0.857	0.5	1	0.054	0.153	20.9%	12.5%

Percent Survived Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	8	0.833	0.684	0.982	0.5	1	0.063	0.178	21.4%	0.0%
20		8	0.896	0.824	0.968	0.833	1	0.0305	0.0863	9.63%	-7.5%
40		8	0.813	0.696	0.929	0.667	1	0.0492	0.139	17.1%	2.5%
80		8	0.75	0.676	0.824	0.667	0.833	0.0315	0.0891	11.9%	10.0%
160		8	0.813	0.674	0.951	0.5	1	0.0584	0.165	20.3%	2.5%
320		8	0.729	0.602	0.857	0.5	1	0.054	0.153	20.9%	12.5%

OCSPP 850.4100 Terrestrial Plant Tier II (Seedling Emergence) **Landis International, Inc.**

Mean Height Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	3	2.2	2	2.2	2.4	1.8	2.3	2.4
20		2	1.8	2.5	2	1.8	2.6	2.5	2
40		2.3	1.5	2	1.8	2.6	2	2.2	2
80		1.6	1.2	1.2	1.5	1.2	1.5	2	1.5
160		1	1.2	1.3	1	1	1.4	1.2	1
320		1	1	1	1.5	1	1.2	1.4	1.5

Mean Weight Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	0.0667	0.166	0.23	0.122	0.074	0.055	0.0917	0.092
20		0.064	0.0617	0.0733	0.07	0.072	0.132	0.157	0.106
40		0.0917	0.05	0.064	0.05	0.078	0.066	0.0783	0.075
80		0.04	0.036	0.026	0.045	0.038	0.0425	0.06	0.055
160		0.0233	0.038	0.0333	0.034	0.022	0.024	0.0283	0.0325
320		0.02	0.0175	0.045	0.026	0.0167	0.026	0.0583	0.03

Percent Emerged Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	1	0.833	0.5	1	0.833	0.667	1	0.833
20		1	1	1	0.833	0.833	0.833	1	0.833
40		1	0.667	0.833	0.667	0.833	0.833	1	0.667
80		0.833	0.833	0.833	0.667	0.833	0.667	0.667	0.667
160		1	0.833	0.5	0.833	0.833	0.833	1	0.667
320		0.667	0.667	0.667	0.833	0.5	0.833	1	0.667

Percent Survived Detail

Group	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
0	Negative Control	1	0.833	0.5	1	0.833	0.667	1	0.833
20		0.833	1	1	0.833	0.833	0.833	1	0.833
40		1	0.667	0.833	0.667	0.833	0.833	1	0.667
80		0.833	0.833	0.833	0.667	0.833	0.667	0.667	0.667
160		1	0.833	0.5	0.833	0.833	0.833	1	0.667
320		0.667	0.667	0.667	0.833	0.5	0.833	1	0.667